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November 12, 1962

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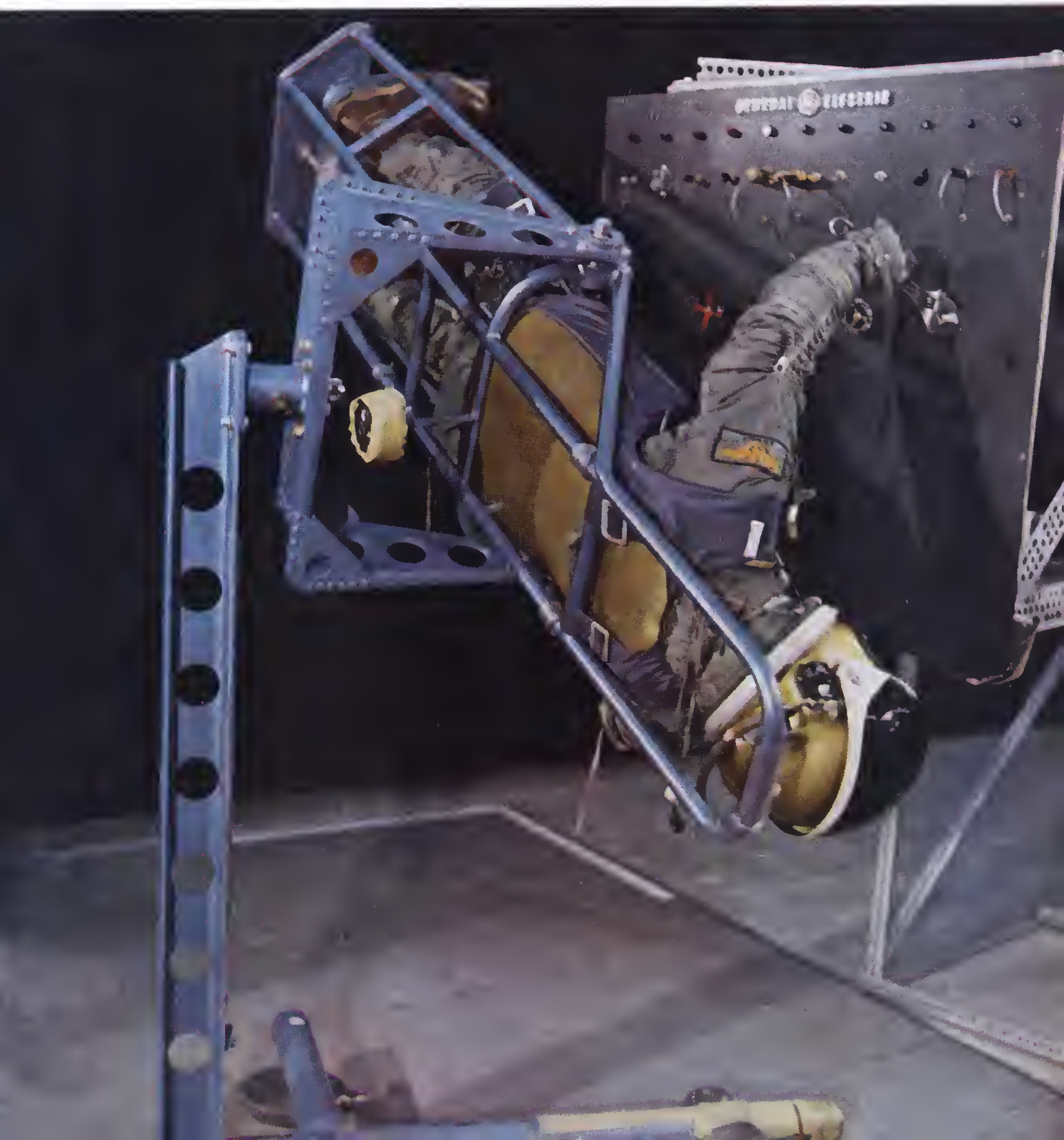

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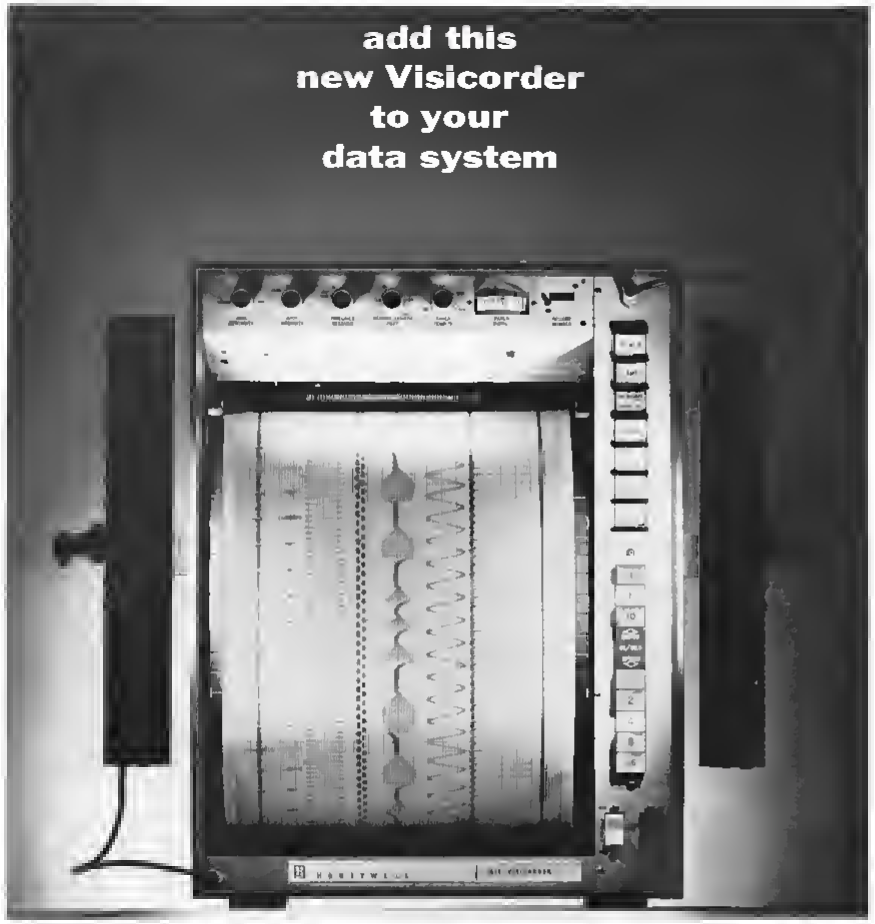

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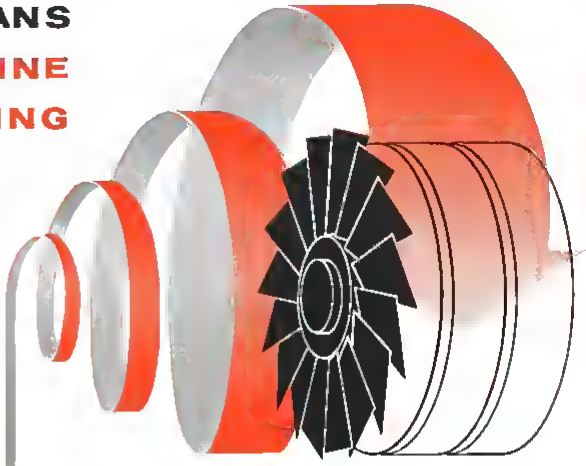

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AEROSPACE CALENDAR

Nov 19-20—Mid America Electronics Conference, IRE, Hotel Continental, Kansas City

Nov. 26-27—Western States Section Meeting, The Combustion Institute, Aerojet-General Corp, Sacramento Calif

Nov. 26-29—Annual Coordinated Meetings American Nuclear Society Atomic Industrial Forum, and joint AtomFair, Sheraton Park and Shoreham Hotels, Washington, D C

Nov 27-29—40th Meeting, Aviation Distributors and Manufacturers Assn, The Kenilworth, Miami Beach, Fla

Nov. 27-29—Fall Meeting Radio Technical Commission for Aeronautics, Marriott Motor Hotel Washington D C

Nov 28-30—1962 Ultrasonics Symposium, Institute of Radio Engineers, Columbia University, New York N Y

Dec 2-6—15th Annual International Air Safety Seminar Flight Safety Foundation Williamsburg, Va (FSF members and by invitation)

Dec 4-6—Fall Joint Computer Conference Sheraton Hotel, Philadelphia Pa Sponsors American Federation of Information Processing Societies, IRE

Dec. 4-6—1962 Convention, National Aviation Trades Assn., Flamingo Hotel, Las Vegas, Nev

Dec. 5—12th Annual National Air Taxi Conference, Flamingo Hotel, Las Vegas

Dec. 6-7—Vehicular Communications Conference, IRE, Disneyland Motel, Los Angeles

(Continued on page 7)

AVIATION WEEK and Space Technology

November 12, 1962

Vol 77, No 20

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AEROSPACE CALENDAR

(Continued from page 5)

Dec. 10-11—First Annual Symposium on Unconventional Inertial Sensors (classified), Republic's Paul Moore Research & Development Center, Farmingdale, N Y Co-sponsors: Bureau of Naval Weapons & Republic Aviation Corp., in cooperation with AFSC Scientific and Technical Liaison Office

Dec. 10-12—Conference on VTOL Aircraft, New York Academy of Sciences, Henry Hudson Hotel, New York, N Y

Dec. 26-31—Space Physics Meeting, American Rocket Society and American Assn. for Advancement of Science, Philadelphia, Pa.

Dec. 27—American Astronautical Society Symposium on Scientific Satellites-Mission and Design, Franklin Hall, Philadelphia, Pa.

Jan. 7-10—Millimeter and Submillimeter Conference Institute of Radio Engineers, Cherry Plaza Hotel, Orlando, Fla.

Jan. 13-16—15th Annual Convention, Helicopter Assn. of America, Cabana Motor Hotel, Palo Alto, Calif.

Jan. 14-18—Automotive Engineering Congress and Exposition Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N Y

Jan. 21-24—43rd Annual Meeting, American Meteorological Society, New York, N Y

Jan. 22-24—Ninth National Symposium on Reliability and Quality Control, Sheraton Palace Hotel, San Francisco, Calif.

Jan. 28—Fifth Annual Army Aviation Contract Services Symposium, International Inn, Washington, D C Sponsor: National Aeronautical Services Assn.

Jan. 30-Feb. 1—Fourth Annual Solid Propellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and also The Franklin Institute, Philadelphia

Jan. 30-Feb. 1—National Winter Convention on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Feb. 5-6—Symposium on Engineering for Major Scientific Programs, Georgia Institute of Technology, Atlanta, Ga.

Feb. 11-15—Third International Symposium on Quantum Electronics, UNESCO Building, Paris, France. Sponsors: International Scientific Radio Union, Office of Naval Research, La Federation Nationale Des Industries Electroniques

Feb. 12-13—Space Vehicle Thermal and Atmosphere Control Symposium conducted by the Aeronautical Systems Division, Engineers Club, Dayton, Ohio. Sponsor: ASD's Flight Accessories Laboratory

Feb. 20-22—1963 International Solid State Circuits Conference, Philadelphia, Pa. Sponsors: Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania

Mar. 7-8—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio

Mar. 11-13—Electric Propulsion Conference, American Rocket Society, Broadmoor Hotel, Colorado Springs, Colo.

(Continued on page 9)

PROBLEMATICAL RECREATIONS 144

An elimination golf tournament is held for $(n+1)$ players. How many golf matches will transpire? —*Contributed*

Systems Engineers with advanced degrees and at least 5 years' experience in digital data processing systems should investigate current openings at our Data Systems Division. Specific areas include: tactical data systems, active tracking, radar/computer interface, digital communications, and mixed mode navigation systems. Qualified applicants are directed to Mr. William T. Short. Call him or simply mail a resume.

ANSWER TO LAST WEEK'S PROBLEM: Exactly 100 yards. The reasoning is that at any moment the hares are at the vertices of an equilateral triangle which diminishes at the velocity of the hares. Hence $\frac{100}{V}$ is the time it takes for the triangle to become a point in the middle of the field. The distance the hares travel during that time is $V \times \frac{100}{V}$ which equals exactly 100 yards.

AEROSPACE CALENDAR

(Continued from page 7)

Mar. 18-20—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Cocoa Beach, Fla.

Mar. 18-21—1963 Western Metal Exposition and Congress, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles.

Mar. 19-21—Second Air Force-sponsored Symposium on Bionics, Biltmore Hotel, Dayton, Ohio.

Mar. 25-28—International Convention, Institute of Radio Engineers, Waldorf-Astoria and Coliseum, New York, N.Y.

Apr. 1-3—Fourth Annual Structures and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, El Mirado Hotel, Palm Springs.

Apr. 2-3—Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, Baibizon Plaza, New York, N.Y.

Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D.C.

Apr. 10-11—Fourth Symposium on Engineering Aspects of Magnetohydrodynamics, University of California, Berkeley.

Apr. 15-17—Hypersonic Ramjets Conference, American Rocket Society and American Society of Mechanical Engineers, Naval Ordnance Lab., White Oak, Md.

Apr. 17-19—International Nonlinear Magnetics Conference, Shoreham Hotel, Washington, D.C. Sponsors: American Institute of Electrical Engineers; IRE.

Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.

Apr. 17-19—Technical Meeting: Nuclear Materials for Space Applications, American Nuclear Society, Netherland Hilton Hotel, Cincinnati, Ohio.

Apr. 22-23—Annual Meeting, National Aeronautical Services Assn., Washington, D.C.

May 2—Biostronautics Conference, American Rocket Society and Aerospace Medical Assn., Los Angeles, Calif.

May 2-3—Fourth National Symposium on Human Factors in Electronics, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington, D.C.

May 7-9—Electronic Components Conference, Institute of Radio Engineers, Marriott Twin Bridges Motel, Washington.

May 13-15—National Aerospace Electronics Conference, Institute of Radio Engineers, Dayton, Ohio.

May 15-17—Connecticut General Flight Forum's Second National Symposium on Air Transportation, Hartford, Conn.

May 20-22—National Symposium on Microwave Theory and Techniques, Institute of Radio Engineers, Miramar Hotel, Santa Monica, Calif.

May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N.M.

May 21-23—National Telemetering Conference, American Federation of Information Processing Societies, Cobo Hall, Detroit, Mich.

June 6-16—25th French International Air Show, Le Bourget, Paris, France.

AUGUST 27, 1923 SAN DIEGO, CALIFORNIA

Yesterday—Droning high over San Diego Bay, two Army Air Service DH-4M biplanes inched closer together. From the craft slightly above and ahead trailed a 40-foot hose, which a man standing in the wind-whipped rear cockpit of the lower plane managed to snag and tie down.

It was the world's first in-flight refueling. The fuel—Standard Red Crown Aviation Gasoline.

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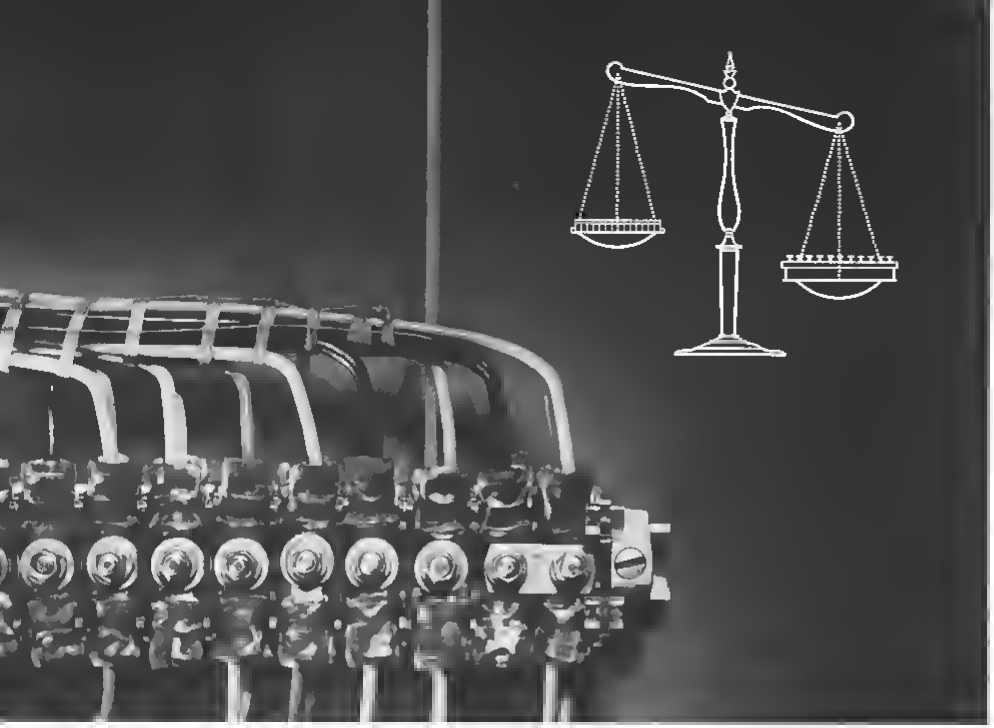

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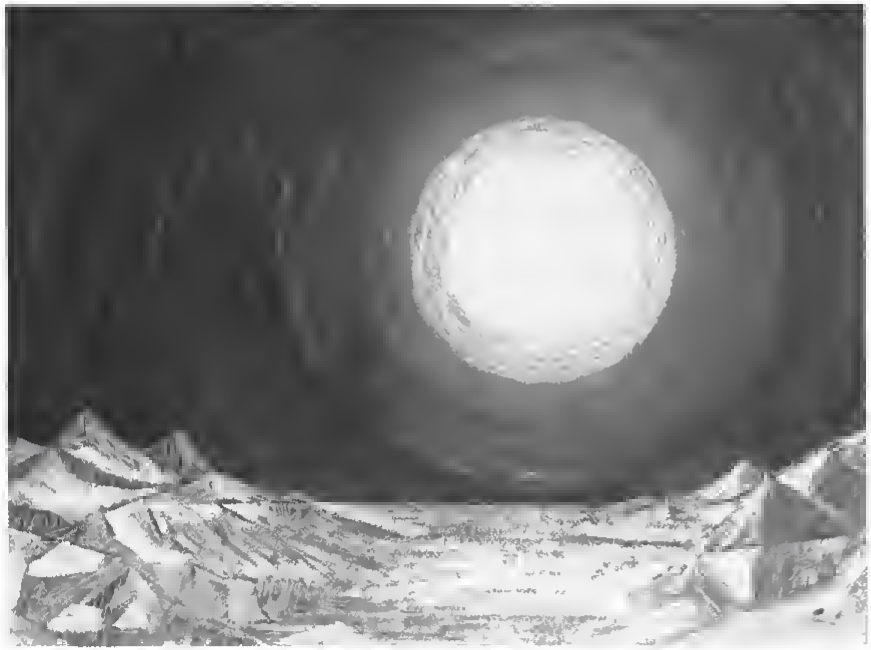
Scientific predictions indicate that solar activity will be at a minimum between July, 1964 and July, 1965. This has been designated as the International Year of the Quiet Sun, and during it a world-wide magnetic survey will take place. □ The Douglas Space Physics and Planetary Sciences Group is studying scientific experiments to be performed on satellite and space probe missions during this period. Instruments to be used will be among the following: magnetometers, ionization chambers, G-M detectors, scintillators, solid state detectors; and spectrometers. □ The present Douglas Antarctica Riometer Station program for the study of cosmic rays will continue through this "Quiet Sun" period and will provide important data relative to solar cosmic ray and auroral events and the geomagnetic K-index. Douglas was invited to participate with the National Science Foundation in this program.

THE YEAR OF THE QUIET SUN
...AND WHAT DOUGLAS IS DOING ABOUT IT



Preparation for the Year of the Quiet Sun world scientific survey is one of more than 500 research projects that are under way at Douglas. Some of these relate to the solution of problems on programs of today and tomorrow. Others range through development and research programs whose effects may not be evident until ten or twenty years in the future.

DOUGLAS

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CONTENTS

COVER: Five degree of motion simulator, designed to aid development of equipment for use outside of spacecraft as well as for training crewmen in maintenance and repair work to be conducted under weightless conditions in space, is in use of General Electric's Valley Forge Space Technology Center. Device simulates frictionless conditions which will be encountered in space. Simulator, called the space worker, began operating in July. Details on p. 76

PICTURE CREDITS
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What Was the Threat?

Now that the Soviet Shyster medium-range ballistic missiles appear to be moving out of Cuba and the immediate threat posed by the establishment of a major enemy offensive base on this unhappy island appears to be dissolving, it might be wise to reflect on just what this threat really was. There is little doubt that if the Soviet design had been completed without any intervention by the U.S., the balance of power in this hemisphere would have been radically altered and a large portion of the U.S. nuclear striking force would have faced serious problems in maintaining its survivability and deterrent capability.

For the moment, let us assume that the capabilities of the Soviet missiles in Cuba were correctly assayed by the official Pentagon and White House spokesmen, although there is considerable evidence that these capabilities were grossly exaggerated. The Shyster MRBMs already in Cuba—Nikita Khrushchev has said that 40 missiles were emplaced there—would have brought a considerable number of Strategic Air Command's bomber bases under a new hair trigger threat that would have impinged dangerously on their 15-min. alert margin. It takes 15-20 min. less for an MRBM launched from Cuba to strike the U.S. than it would for an ICBM fired from the Soviet Union to hit the same target. It is this slender margin of 15 min. on the end of a 30-min. ICBM flight on which SAC depends to get a large portion of its retaliatory bomber fleet into the air and away from vulnerability to a missile attack. But with a 10- to 15-min. interval between MRBM launch from Cuba to impact on SAC fields in the southern United States where they have been concentrated to be at the extreme edge of Soviet ICBM ranges, the bomber fleet's scramble margin becomes dangerously thin and its principal force could be reduced to the planes already airborne in the continuous airborne alert.

Questionable Range

There is considerable skepticism that the MRBMs in Cuba have the 1,000-mi. range claimed for them by U.S. official spokesmen and a strong suspicion that this alleged intelligence was tailored to fit political goals. These same MRBMs, displayed in Moscow parades for a number of years, were never previously credited with much more than 500-mi. range. Using alcohol fuel and red fuming nitric acid as an oxidizer, their propulsion efficiency makes even this range with a fractional megaton warhead optimistic.

However, the alleged threat posed by 1,000-mi. range MRBMs would have become genuine with the arrival of the 1,200-mi. range IRBMs, for which launching pads were being constructed in Cuba. Why the IRBM that has been carried in the official U.S. appraisal of the Soviet inventory for many years as roughly a 1,200-mi. weapon was suddenly stretched to a 2,200-mi. range has never been satisfactorily explained by any of the Pentagon or White House spokesmen making these claims, nor is it likely that there ever will be such an explanation. These official manipulators of the news will fall back behind the curtain of "military secrecy" for their defense against these charges.

Some Washington observers cynically claimed these Soviet missile ranges were deliberately stretched before the November election to include more states in the potential target areas. Lack of any technically sound information on these missiles by the official spokesmen making the extended range claims lends credence to the cynics' view.

There has been a tendency to overlook the role of the Soviet Il-28 Beagle fleet in this military picture. This is a venerable veteran of the early subsonic jet age and no match for any modern air defense system using the latest radar, supersonic interceptors and air-launched missiles. However, when the Il-28s arrived in Cuba, there was no effective air defense system guarding the southeastern approaches to the United States. Even when this defect was remedied, the Il-28s still remained a potent military asset to Castro's Cuba.

Reconnaissance Capability

Their 800-mi. radius of action gave Castro a reconnaissance capability over the entire Caribbean area that he previously lacked.

They also gave him the capability for air dropping agents and arms to foment Communist revolt in Central America, other islands in the Caribbean and in oil-rich Venezuela. They also provided a quick capability for external support from Cuba for any "internal" revolutions in those countries. Against the World War 2 surplus piston-powered fighters of these nations, the Il-28 still would be a potent weapon. Therefore the Soviets tried as long as possible to keep the Il-28s in Cuba, out of the scope of the "offensive weapon" evacuation agreement, and went on uncrating and assembling them at San Julian airfield long after the MRBM bases were being abandoned.

What the Soviets hoped to accomplish with their missile and bomber base in Cuba can only be conjectured. But there is one solid piece of evidence that made clear their aggressive intent. All of the missile sites were constructed in a "soft" pattern useful only for a surprise first strike attack, and of absolutely no value as a potentially survivable retaliatory force. The difference between the soft site pattern in Cuba and the hardened sites in which most USAF ICBMs are emplaced is the best evidence yet of the Soviet's aggressive intentions, although how this missile blackmail would have been executed we, fortunately, may never know.

Even with the Cuban fangs drawn from the Soviet dragon's offensive power, the question of the future of this strategically located island remains in doubt as long as it remains under Communist control. Only part of its threat to the U.S. and the rest of the hemisphere will be removed with the departure of the Soviet missiles and bombers.

—Robert Hotz

WHO'S WHERE

In the Front Office

John B Cowen, president, Aerojet-General International Corp., with offices in Paris, France. Other officers are **James R. Corcoran, Jr.**, vice president; **Gen D. L Van Sickle**, vice president and treasurer; **Cecil Z Wawra**, vice president and secretary; **James N Ebright**, assistant secretary.

C J Miguault, a vice president and treasurer, Rolls-Royce of Canada Ltd., Montreal, Canada. Also **G L. T Rayner**, secretary; **George A. Morris**, comptroller.

Dr. William E. Shoupp and **Dr Sidney Krasik**, vice presidents, Westinghouse Electric Corp., Pittsburgh, Pa. Dr. Shoupp is general manager of the Westinghouse Research Laboratories, and Dr. Krasik is general manager of the company's Astronuclear Laboratory.

James K Dysart, president, Lionel-Pacific Inc., Los Angeles, Calif.

Ivan J Dornbush, president, Technology Instrument Corp. of California, Newberry Park, Calif., a subsidiary of Bowmar Instrument Corp.

Francis J Gundersen, vice president finance, Kollsman Instrument Corp., Elmhurst, N. Y., a subsidiary of Standard Kollsman Industries Inc.

Philip L Graham, president of the Washington Post Co. and chairman of Newsweek Magazine, has been named chairman of the Communications Satellite Corp. (AW Oct. 15, p. 37) by the incorporators.

Samuel J Davy, vice president-engineering, National Company, Inc., Malden, Mass.

Eugene J Finn, vice president aeronautical marketing, The Firewel Company, Inc., Buffalo, N. Y., a subsidiary of the Aro Corp.

William F. Cairns, Jr., executive vice president and vice president manufacturing, Maxson Electronics Division of Maxson Electronics Corp., New York, N. Y., and **Murray Simpson**, vice president research and development.

David M Fleming, assistant to Gen. Donald L. Putt, president of United Technology Corp., Sunnyvale, Calif., a subsidiary of United Aircraft Corp.

Robert O Johnson, vice president marketing, Consolidated Vacuum Corp., Rochester.

Howard Fulver, president, Sterling Transformer Corp., Brooklyn, N. Y.

J. I Hamilton, vice president staff director and secretary and treasurer, Menasco Manufacturing Co., Burbank, Calif.

Dr Urner Liddel, chief of sciences for lunar and planetary programs, Office of Space Sciences, National Aeronautics and Space Administration, Washington, D. C.

Honors and Elections

O. F. Stem, director of cargo sales for Eastern Air Lines, has been elected 1963 chairman of the airline industry's Air Express Committee, Air Transport Assn. of America. Ernest E. Washburn, air cargo manager for Lake Central Airlines, was elected vice chairman.

William B Johnson, president of REA Express, has been elected president of the National Defense Transportation Assn., Washington, D. C.

INDUSTRY OBSERVER

► Potential of hybrid rocket motors is receiving increased attention from various National Aeronautics and Space Administration planning levels for manned and unmanned spacecraft applications. First detailed NASA effort probably will be a feasibility study involving design and performance characteristics of a liquid-solid system for unmanned vehicles, such as those to be used in support of lunar operations. All major propulsion contractors and some other aerospace companies, including Northrop, are investigating hybrid systems.

► **General Electric J93 30,000-lb.-thrust engine, six of which will power North American Aviation's B-70 Mach 3 aircraft, will not be flight tested before actually flying with the B-70. Original plans to test the engine in a pod slung under a General Dynamics B-58 bomber were scrapped in favor of Mach 3 tests in an environmental chamber at Arnold Engineering Development Center, Tullahoma, Tenn.**

► Speed increase of 30 mph. has been achieved by modifying a conventional Bell IIU-1 Iroquois single-turbine helicopter to reduce drag by streamlining the fuselage and altering the main rotor mast to provide tilt (AW Oct. 22, p. 32). The experiment is part of an Army program to develop a new class of armed attack helicopters for support of ground troops.

► **Award is expected by the end of this month in Advanced Research Projects Agency's competition for development of a high-energy solid propellant giving a substantial jump, possibly 30 to 35 points, over the specific impulse value of about 245 available in present state-of-the-art applications.**

► Bureau of Naval Weapons plans to develop an integrated all-weather avionics system for helicopters and VTOL aircraft, using microcircuitry wherever possible. The system will include navigation, autopilot, terrain avoidance radar displays, communications, identification (IFF) and other instrumentation needed for all weather point-to-point operations at low levels and inflight station keeping. Companies interested in bidding on the system must advise BuWeps, Code RAV 111, by Nov. 16.

► **Avro Blue Steel standoff bomb, interim nuclear air-to-ground weapon for Royal Air Force V-bombers, will be in service before the end of the year. Blue Steel will eventually be replaced by the Douglas Skybolt on the Avro Vulcan 2 bomber series.**

► Last of the 100 in.-dia. solid propellant motors fired recently by Aerojet-General (AW Oct. 22, p. 35) at its Sacramento, Calif., facility used a mechanical tab, or spoiler, in the exhaust stream for thrust vector control. This was the first application of this method in motors of that size. The tab, capable of about 4½-deg. deflection from neutral, created a sonic rebound which destroyed the insulation at the junction of the nozzle throat after an otherwise successful 90-sec. firing. A small solid fuel motor was used for ignition. In flight hardware, the small motor would remain on the pad after launch.

► **Strategic Air Command has reduced the number of B-52 jet bombers scheduled for modification at Boeing-Wichita and other facilities as a result of the command's increased alert posture during the Cuban crisis.**

► USAF Electronic Systems Division has recently established a new support system—designated 481L Post-Attack Command and Control System—which is intended to enable Strategic Air Command to control its forces if normal facilities are destroyed.

► **National Aeronautics and Space Administration's Manned Space Flight Center in Houston is expected to issue a request for quotations soon for implementation of an integrated mission control center (IMCC). Among companies which probably will bid are Bendix, IBM, Philco and Radio Corp. of America. This is the second of two prime contracts for the control center (AW Oct. 22, p. 26).**

Washington Roundup

Powers Flies U-2 Again

Francis Gary Powers, whose U-2 was downed in Russia in 1960, is now an engineering test pilot for the Lockheed California Co., flying U-2s in local test flights out of Burbank. Central Intelligence Agency says Powers quit his job there last Oct. 6.

Cuban newspapers printed photos of what they said was the wreckage of the U-2 flown by Maj. Rudolf Anderson, Jr. Cuba said the Strategic Air Command U-2 was "shot down by our anti-aircraft forces on Oct. 27." Defense Dept. still refused late last week to comment on that. Cuba said the U-2 "can glide with motors shut off for nine hours. These spy planes are equipped with 15 infrared cameras specially designed for espionage work."

SAC Commander Gen. Thomas S. Power attended Maj. Anderson's funeral at Greenville, S. C., last week and identified Anderson and Maj. Richard S. Heyser as the two reconnaissance pilots who last Oct. 14 obtained the first conclusive evidence of the Soviet missile buildup in Cuba.

Congressional Changes

A woman will become the top Republican on the Senate space committee next year. Sen. Margaret Chase Smith of Maine will take over the spot formerly held by Sen. Alexander Wiley of Wisconsin, who was defeated in last week's elections. Sen. Homer Capehart (R-Ind.), another Senate space committee member, also was defeated. Two House space committee members, both of whom were strong proponents of more large solid rocket development, also will be missing next year. Rep. Victor Anfuso (D-N. Y.) was elected to New York's supreme court and Rep. David S. King (D-Utah) lost a bid for a Senate seat held by Republican Wallace F. Bennett (AW Oct. 8, p. 25).

Rep. James Van Zandt (R-Pa.), a high ranking member of the House Armed Services Committee and Joint Atomic Energy Committee, also lost a bid for a Senate seat and Rep. Peter Mack (D-Ill.), a top member of House Commerce Committee, was defeated.

Pan American World Airways and KLM Royal Dutch Airlines were making plans late last week for resuming regular flights to Havana. Cuba announced that regular service, halted when the U. S. arms blockade began, could be resumed if plan for each flight was filed with Havana air traffic control.

Nuclear Test Outlook

Soviet refusal to allow inspection of underground tests on its territory is likely to continue to delay any nuclear test ban agreement. The U. S. ended its atmospheric series on Nov. 4 with detonation of a payload having a yield of about 30 kt. It was launched by a Nike Hercules. Russia plans to end its tests on Nov. 20. The U. S. exploded 36 devices in the atmosphere, including five at high altitudes. Russia had exploded 31 in the atmosphere between early August and Nov. 7.

Algeria received nine Soviet-built aircraft, including five MiG-15 trainers, from United Arab Republic President Gamal Abdel Nasser on the eighth anniversary of the Algerian revolution. Soviet instructors flew in each aircraft as copilot when the planes landed at Algiers' Maison Blanche air base.

Yugoslav military mission, headed by the deputy minister of defense and commander of the Yugoslav naval forces, visited Cairo recently for UAR Army Day celebrations.

Top officials of National Aeronautics and Space Administration met Nov. 3 with Budget Bureau Director David Bell for final deliberations on the agency's Fiscal 1963 supplemental budget request and the Fiscal 1964 requests (see p. 27). The two will total about $6 billion.

Cuba Crisis News Probe

House Government Information Subcommittee is laying the groundwork for hearings, possibly early next year, on the way the Kennedy Administration "managed" news during the Cuban crisis. Chairman John E. Moss also hopes to go into why the Pentagon's space secrecy directive of last Mar. 23 is itself classified secret (AW May 21, p. 26). Defense Secretary Robert S. McNamara wrote Rep. Moss about the directive some time ago but Rep. Moss would not accept the letter because it was marked "secret." Subcommittee staffers already have interviewed top information officials in the Pentagon, State Dept. and White House.

Administration refuses to let NASA identify the Mercury tracking stations that will be modified for Gemini missions so the nations involved can take political advantage of announcing it first themselves. The sites are expected to be in Bermuda, Mexico, Canary Islands and South Africa. New stations are expected to be built in Hong Kong and Chile (AW Feb. 5, p. 23). NASA has awarded Electro Mechanical Research $7.4 million for pulse code modulated systems, Radiation, Inc., $1.9 million for digital command encoders, Collins Radio $1.7 million for radio frequency command systems, and Canoga Electronics Corp. $1 million for tracking antenna acquisition aid systems.

—Washington Staff

Manned Venus, Jupiter Satellites Planned

NASA's long-range timetable includes stations on the moon, Mars; U.S. to search for life on other planets.

By Edward H. Kolcum

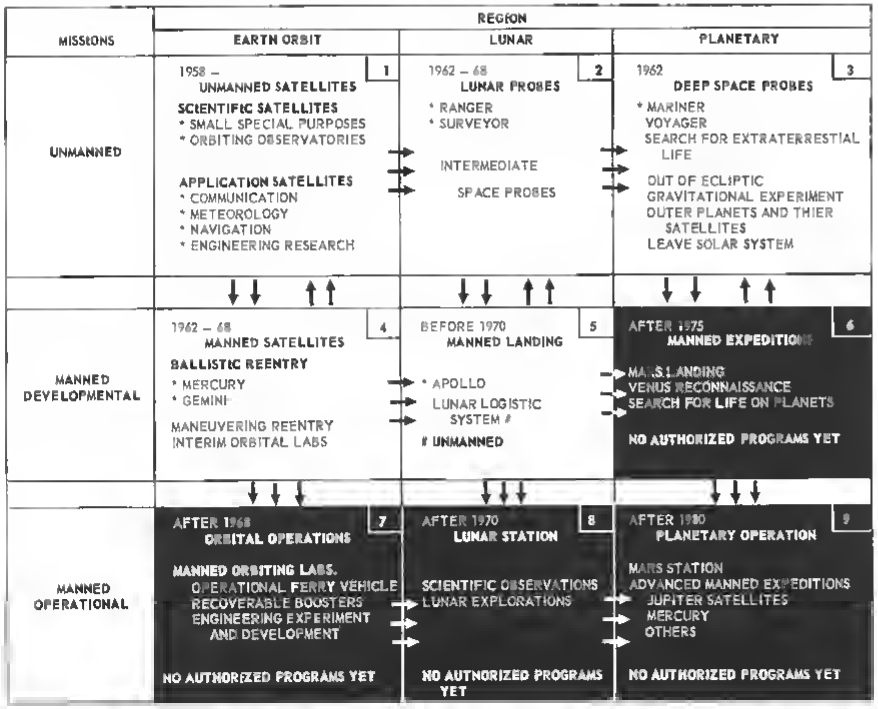
Chicago—Manned satellites of the planets Jupiter and Venus are part of the U.S. long-range space exploration plan, which was outlined by the National Aeronautics and Space Administration here at the NASA University conference on space science and technology.

Abraham Hyatt, director of NASA plans and program evaluation, said the timetable for the plan (see chart) is highly tentative, but it reflects the trends of basic research needs. The role of universities in the NASA program includes a wide range of fundamental research under grants and contracts, as well as the fact that they will be the source of the space agency's scientists and engineers.

Hyatt said preliminary analytical work is under way for a large number of space exploration programs that are not yet authorized or funded. These are highlighted by operational manned flights beginning after 1968 with space stations in earth orbit. The plan extends as far as the post-1980 period, when a manned station could be operating on Mars and manned satellites could begin orbiting Jupiter and Mercury. Between these milestones would be establishment of a lunar station, development of maneuvering re-entry vehicles, a Mars landing, Venus reconnaissance and a search for life on other planets, all of which would be manned.

Hyatt said major obstacles are:

- **Money**, and the way in which NASA's program will be funded in the future. In planning the long-range program, the agency anticipates a gradual leveling off after the funding peak is reached in the Apollo manned lunar landing program. It expects to be able to achieve new funding peaks as advanced manned expeditions and operational programs are authorized.
- **Time-energy barriers**, in the context of the actual time it takes for manned vehicles to make interplanetary trips. Minimum energy Mars trip, for example, will take 970 days.
- **Physical barriers** of chemical propellants for launch vehicles. This should be overcome with nuclear and electric



LONG-RANGE U.S. SPACE EXPLORATION plan is shown in this chart, with stars indicating programs which have been approved. Projects in boxes 6 through 9 are under preliminary studies, and are not approved or funded.

NASA Funding Problems Slow Lunar Program

Washington—Funding problems have forced the space agency to fall several months behind schedule in its top priority program to land a man on the moon before the end of this decade.

Aviation Week learned from interviews with National Aeronautics and Space Administration officials and their contractors that orders to decrease the pace of the lunar landing program have been issued as part of an economy campaign, which already looks as if it will force the program as much as seven months behind schedule.

Some space authorities both inside and outside NASA fear the slowdown may reduce the sense of urgency which has been so instrumental in persuading Congress to appropriate the billions needed for an all-out national space program. If NASA itself slackens the pace of the program, these officials argue economy minded members of Congress will have a stronger argument for reducing or stretching out the space agency's appropriations. A slower paced program also is likely to lose some of its public appeal, especially if the U.S. space effort falls farther behind Russia's.

NASA Administrator James E. Webb decided before Congress adjourned not to ask for the supplemental funds which because of contractors revised estimates were needed to keep the lunar program on schedule. Faced with the prospect of running out of money before next year's Congress appropriates additional funds for NASA, space agency officials have resorted to several economy measures ranging from delaying the award of contracts to reducing the scope of activities.

The pinch already is being felt by several aerospace contractors working on various segments of NASA's lunar landing program. Some examples:

- McDonnell Aircraft Corp., prime contractor for the Mercury and Gemini capsules, has been ordered by NASA to reduce overtime. McDonnell employes now are at Cape Canaveral working two-shift, five-day week instead of the two-shift, six-day week which they usually work from the time a capsule arrives until it flies. Also the only overtime being worked by McDonnell employes at the Cape for the past two weeks has been on the attitude control system for the Mercury Atlas-9 capsule. These and other economy moves are partly responsible for the MA-9 launch date slipping from February to April. Economy measures are also expected to delay for four months the construction and launching of the two-man Gemini capsule.
- The Martin Co. is laying off 225 of its 10,500 workers at its Baltimore plant, partly because NASA is delaying the work orders for the Titan 2 booster—Gemini launch vehicle—as part of its economy drive. This layoff would have been necessary, according to company officials, even if Martin had been awarded the NASA contract for the lunar excursion module (LEM). However, the LEM award (see p. 29) would have enabled Martin to recall the laid-off workers after the contract was negotiated.
- Construction of several assembly and checkout facilities at Cape Canaveral related to the lunar landing program is being stretched out. Any delay in construction causes slippage all along the line. Estimates of the total program's slippage range from four to seven months.

Brainerd Holmes, NASA's manned space flight director, several months ago wrote Chairman Olin E. Teague (D-Tex.) of the House Science and Astronautics manned space flight subcommittee that his program would be short of funds this fiscal year. But evidently Administrator Webb, partly because of the Fiscal 1963 budget deficit facing the Kennedy Administration, ignored pleas of his associates to ask for more money before Congress adjourned or to commit NASA to existing time schedules with the idea of getting the additional money from Congress early next year. Fiscal 1963 deficit in the manned lunar program is approaching $300 million (AW Sept. 3, p. 16).

Progress of NASA's next sizable contract—the lunar supply system—will indicate the breadth of the agency's economy campaign. This system (AW Aug. 13, p. 30) involves development of two spacecraft carriers and propulsion systems and determination of the payload.

stages. Progress in developing these stages, Hyatt said, has been slower than was predicted.

Hyatt spoke at the plenary session of the three-day conference which opened Nov. 1. D. D. Wyatt, director of NASA programs, said at the same session that the long-range planetary plan includes unmanned probes to Mercury and Neptune.

Wyatt said also that man's role in satellite flights will continue to be as the subject for behavioral observation until his scientific role is more clearly defined from such operations as orbiting laboratories and space stations.

After the plenary sessions, conferees went into two days of technical meetings during which NASA spokesmen emphasized the projects most readily adaptable to university fundamental and applied research. Dr. Adolph Busemann, senior staff scientist at Langley Research Center, for example, urged educators to improve teaching in the fundamentals of fluids in motion so that students can better contribute to urgently needed knowledge in that area.

Miss Eleanor Pressly of Goddard Space Flight Center said university participation in sounding rocket programs may reach 43% of the NASA total this year, and she called on conferees to increase university participation even more.

Miss Pressly outlined requirements for NASA assistance in rocket experiments. This basically involves submitting a proposal and a statement on the support needed from NASA. The government provides launch vehicle, power supply, telemetry, performance and aspect gages, calibrator, commutator and all rocket wiring outside the experimental package. The experimenter is responsible only for his own scientific instrumentation.

Dr. Dale Smith, deputy assistant director for Life Sciences at NASA's Ames Research Center, said that universities and research organizations will do more than 75% of NASA's bioastronautics work during the coming year, and that NASA will probably never do more than 50% of its own bioastronautics work in house.

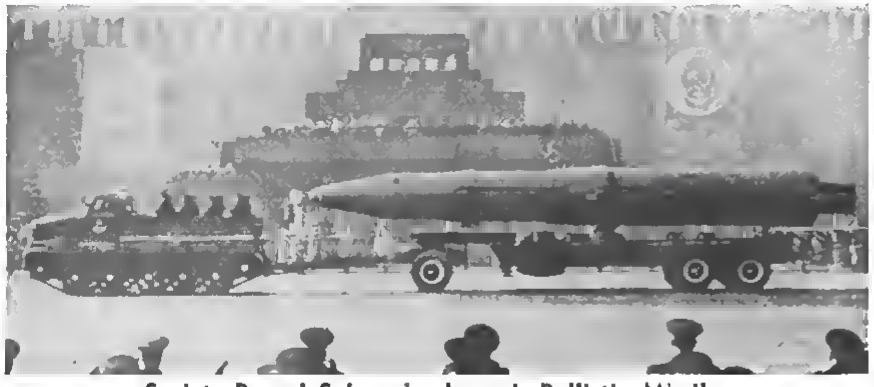
Jet Propulsion Laboratory spokesmen cautioned that it would be dangerous and overly expensive to neglect earth-based scientific experiments simply to launch a payload into space, and the objective will be to support earth-bound as well as space vehicle experiments.

Other highlights of the two days of technical sessions were:

- **Nuclear propulsion**—NASA is studying advanced solid core and gaseous core reactors which could power rockets. Properties of refractory materials and how practical design of fuel elements able to withstand high flow rates, heat fluxes and thermal cycling.

Role of the university in this research will be to contribute data on the properties of refractory materials and to contribute data on how they are influenced by uranium fuel.

- **Aerodynamics problems** of space vehicle flight within the atmosphere are now better understood after several early failures caused by underrating aerodynamic effects. NASA is conducting analytical studies of recoverable



Soviets Reveal Submarine-Launch Ballistic Missile

First photo of a Soviet naval ballistic missile, described by the Russian newspaper Izvestia as capable of launch from submarines, shows unusual organ pipe configuration at nozzle end. Spectators at the Bolshevik revolution anniversary parade last week, where it was unveiled, said it consisted of seven tubular sections. a numerical pattern similar to that shown in a non-technical Russian drawing of the Vostok booster (AW Aug. 27, p. 35). Rounded nose cone, probably embodying a heat sink or an ablative re-entry system, is evidence that the new missile has greater range than previously shown Soviet ballistic missiles with pointed nose cones. The missile is about 50 ft. long, shorter but wider than the Shyster medium-range ballistic missile emplaced in Cuba (AW Nov. 5, p. 34). Flared sections indicate a three-stage missile, and increased weight-carrying capacity of the trailer over that used for Shyster is evidence of solid or storable propellant use. Tow vehicle, the same as that used for Shyster, is manned with North Fleet personnel. U. S. Navy has long had photo evidence of the existence of Russian missile launching submarines (AW Oct. 8, p. 87).

planetary probes which will re-enter the atmosphere at velocities as high as 60,000 mph.

▪ **Space science** research—Greatest impact of space astronomy will be its contribution to ground-based astronomy and astrophysics. Research in optics and solid state properties demanded by space astronomy already has resulted in new optical coatings, metal mirrors and ultraviolet photo-emitters.

Energetic particle and magnetic field research is aimed at determining particle acceleration, generation of magnetic fields in stars, planets and space and the motions of fields and matter in space. This is expected to lead to an understanding of the development and dynamics of galaxies, distribution of matter in galaxies and the physical processes which occur in and near stars and planets.

Although space vehicle studies of the chemistry and physics of the earth's atmosphere, called aeronomy, have provided excellent fundamental knowledge of the gas cloud around the earth, they have also opened a broad new field of unknowns. Among the most interesting space goals, already identified, are attainment of a true ambient sample, interpretation of measured values of atmospheric samples in terms of true ambient conditions, conversion of small currents in the range of 10^{-17} amp to five-volt signals, development of improved sensors, increasing sensor reliability, absolute measurement in an ultra-high vacuum, and generation of known and controllable means of neutral particles.

In regard to physical constants, better data are needed on gas reaction coefficients, absorption cross sections and gas-solid reaction coefficients.

Space payload measurements of the ionosphere since 1959 have resulted in a more accurate atmosphere model up to altitudes of 1,300 mi., but gaps exist in ionosphere data and in instruments to obtain this knowledge.

▪ **Structures**—Dynamic modeling methods used by Langley Research Center in structural research of the Saturn C-1 launch vehicle have proven successful for designers of large launch vehicles. Scalloped tank configuration may be used for large vehicles because it provides structural strength and prevents fuel sloshing. NASA also is investigating dimpled sheet sandwich materials, refractory metals such as tungsten, tantalum, molybdenum and columbium, coated with silicon and graphite.

Sterilization techniques being studied use heat, radiation and gas, ethylene oxide or Freon 12. The problem of how to sterilize vehicles returning to the earth has not yet been faced.

▪ **Materials**—It is estimated that within 10 years, half the components launched into space will be made of non-metallic materials. Polymers, although affected by the space environment, are considered less so than previously and work is under way to increase useful operating temperatures of polymers from 400F to 800F.

Among advanced materials under study for space application are powdered metals, re-formed under high pressures and temperatures, new alloys of tungsten, molybdenum, titanium and zirconium, and composite materials containing high-strength fibers.

▪ **Gas dynamics**—Intensive research is required on influence of high enthalpy on the thermochemistry and of ionization on the flow field containing foreign gases. Effect of ionization on convective heat transfer appears to be small. Turbulent boundary layer in high enthalpy flows is another area open for experimental and theoretical research.

The intense radiation of ultraviolet light by gases behind the bow shock wave may produce a subsonic "warning" to the air that a body is approaching, because this radiation may be absorbed in the flow region ahead of the shock.

▪ **Space navigation**—Studies indicate that a combination of a sextant and an on-board computer may provide accurate position, velocity, trajectory and correction data for translunar flight.

▪ **Magnetohydrodynamics** research has resulted in development of a coaxial plasma accelerator at Langley which has generated a plasma burst with a velocity of 670,000 mph.

Grumman Wins Lunar Bug Contract

Washington—Grumman Aircraft Engineering Corp. has been selected to develop and produce the lunar excursion module (LEM) which will land two men on the moon in the Apollo project. National Aeronautics and Space Administration estimated the contract value will total $350 million.

Because this project is not included in the agency's Fiscal 1963 budget (see p. 26), NASA will either have to drastically reprogram its approved projects, or request supplemental funds to cover the contract (AW Sept. 3, p. 16).

It is expected that Rocketdyne Division of North American Aviation will receive the prime propulsion subcontract. Although Radio Corp. of America was proposed by Grumman as the telecommunications subcontractor, NASA may specify Collins Radio for this project to assure compatibility with Apollo command module instrumentation. Collins has the contract for this Apollo system, and Grumman was the only bidder not teamed with this company.

Final selection of Grumman for the contract had been made in mid-October. NASA technical review board had previously considered the Grumman proposal the best of nine submitted, as reported by Aviation Week (Oct. 1, p. 15). Announcement apparently was delayed to eliminate charges that the award was made to influence the November elections. Announcement was made Nov. 7, the day after the election, even though NASA Administrator James E. Webb, who made the final selection, was on vacation at the time.

Decision to award the contract for the lunar excursion module, called the bug, indicates that NASA will press forward with its selection of the lunar orbit rendezvous technique for the Apollo program, despite objections which have been raised regarding the complexity of this technique.

General configuration of the bug (see AW cover, Oct. 1) is similar to the pilot compartment of a helicopter. It will be about 10 ft. in dia., and 15 ft. high with its landing legs deployed. Weight is expected to be 20,000-25,000 lb.

NASA considers that the propulsion system development is one of the most difficult in the bug project. The agency has specified earth storable bipropellants for both lunar letdown and lunar takeoff engines. Letdown engine will be throttleable over a 1,000-lb. thrust to 10,000-lb. thrust range, and the lunar takeoff engine will have a 4,000-lb. thrust.

U.S. Plans Massive Assistance If India Will Stand With West

Washington—Initial military airlift of light infantry weapons to India was completed last week and U. S. policy toward that country entered a new stage which could result in a massive military and economic assistance program.

Kennedy Administration officials were assuming a wait-and-see attitude on the main question of whether India would disavow its neutralist stand and side with the West, in the face of Russia's endorsement of territorial claims made by Communist China as Chinese troops continued to advance into India (AW Nov. 5, p. 26).

But it is obvious that the Administration is ready to go far beyond this military airlift to help India both militarily and economically if Indian Prime Minister Jawaharlal Nehru gives the word. Nehru last week said aid from the U. S. and Britain would not change India's policy of non-alignment, adding that his country had also sought assistance from "other friendly countries," including Russia and France. However, U. S. officials are discussing the possibility not only of supplying heavier military equipment, including aircraft, but of sending in technicians to help build up India's general industrial production facilities.

Defense Dept. confirmed last week that the U. S. Army gave up its production line priorities for two de Havilland DHC-4 Caribous so they could be supplied to India. Officials indicated the U. S. would pay for the aircraft and decide later how India should reimburse the government.

Significantly, funds for light infantry weapons and other equipment airlifted to India have come from Military Assistance Program account. India has steadfastly refused to become involved in the Military Assistance Program so far, and also insisted that it pay in cash for any military equipment. The Caribou transaction may well set the pattern for the next stage of the U. S. assistance program to India. U. S. officials also indicated that Indian rupees would be acceptable to the U. S.

India's military leaders long have wanted to increase their airlift capability but have been prevented from buying U. S. aircraft by former Defense Minister V. K. Krishna Menon. But this obstacle was removed last week when Menon, who already had been demoted by Nehru to defense production minister, left the Indian cabinet altogether. The Indian government, with U. S. government financial help, is now expected to buy other military transports and helicopters from the U. S., Britain and Canada.

But U. S. defense officials do not foresee any sizable purchases of tactical aircraft by India in the near future. They note that neither India nor China has used such aircraft in the fighting so far and they feel that the Indian air force is equal or better than Red China's. Red China has MiG-15s, 17s and 19s—but no MiG-21s—and some Soviet Il-28 bombers. These officials estimate India has 300 jet aircraft, including Hawker Hunter fighters and English Electric Canberra tactical bombers.

The U. S. military airlift of automatic rifles, anti-personnel mines, 81-mm. mortars, mountain artillery and communications equipment began Nov. 2 from Rhein-Main, West Germany. Late last week, U. S. officials said India's urgent needs had been met with the lending of about $5 million worth of equipment.

Most of it came from U. S. Army stockpiles in Western Europe.

USAF Brig. Gen. Robert D. Forman, commander of the Military Air Transport Service 1602nd Air Transport Wing, supervised the operation from headquarters in Calcutta. MATS Boeing C-135s took off from the Rhein-Main air base every three hours, each loaded with 40,000 lb. of military equipment. The schedule called for eight flights a day, with a two-hour stopover at Adana, Turkey, before making the six-hour flight on to Calcutta. Total elapsed flight time was about 13 hr.

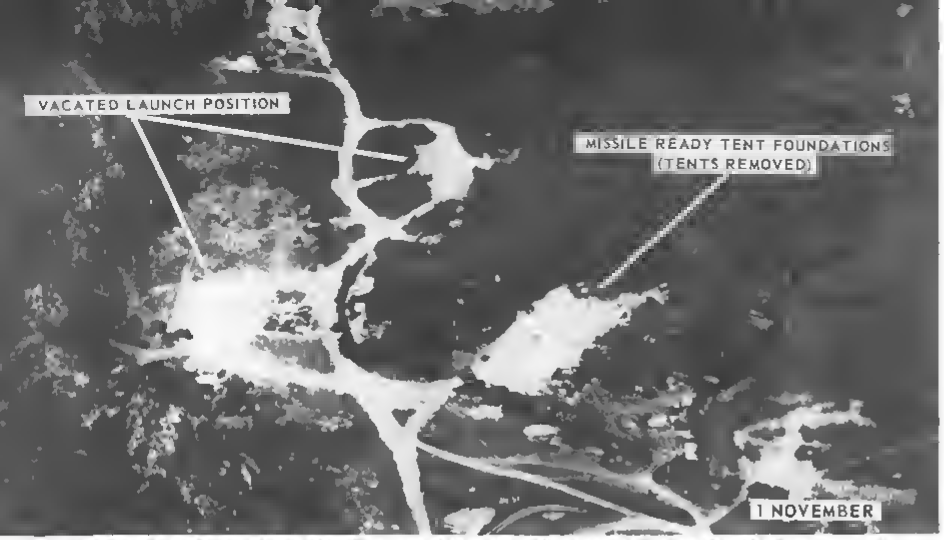
After the aircraft landed at Calcutta, Indian forces took the military equipment toward the front by truck, helicopter and aircraft, including modified Fairchild C-119s (see p. 127).

Post-Nova Studies

NASA's Marshall Space Flight Center is considering allocation of additional funds for extending studies now being conducted by Douglas Aircraft Co., General Dynamics/Astronautics and Rand Corp. on very large post-Nova boosters.

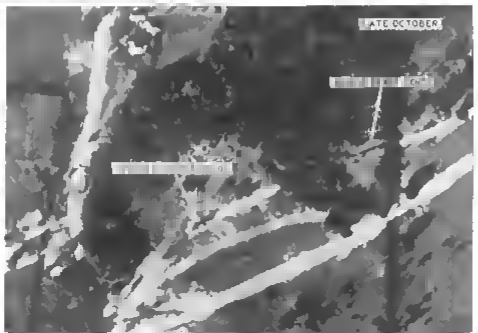
Boosters would have a minimum payload capability equivalent to the maximum envisioned for the basic Nova—about 400,000 lb. for low earth-orbit.

Present studies scheduled for completion before the end of the year under funding of about $75,000 per company, probably would receive similar sums for extension.



Missile erectors and canvas deflectors have been removed from the medium-range missile site at Sagua La Grande, new aerial reconnaissance photographs of Cuba show. Missile ready tents also have been removed from foundations. Launch control buildings (center, near lower launch pad) remain and trucks are parked at various places at the site. This location was pictured on the cover of Aviation Week and Space Technology Nov. 5, and on pp. 34 and 54.

Another launcher-erector has disappeared from a medium-range ballistic missile site, one of those in the San Cristobal area, reconnaissance photo (above) indicates. The same site in mid-October photo (right) had launcher in position and two missile ready tents, partly hidden among the trees at right. Tents have also disappeared, though concrete foundations remain. These photos are a close-up of one of four launching pads under construction at the site (AW Nov. 5, p. 33, bottom) but was not specifically labeled as a launch pad in previous Defense Department photos. Roofless concrete structure is still standing near the launching position in latest photo. Note signs of grading to the right of the launching site and degree of activity in the area, denoted by truck tire marks.

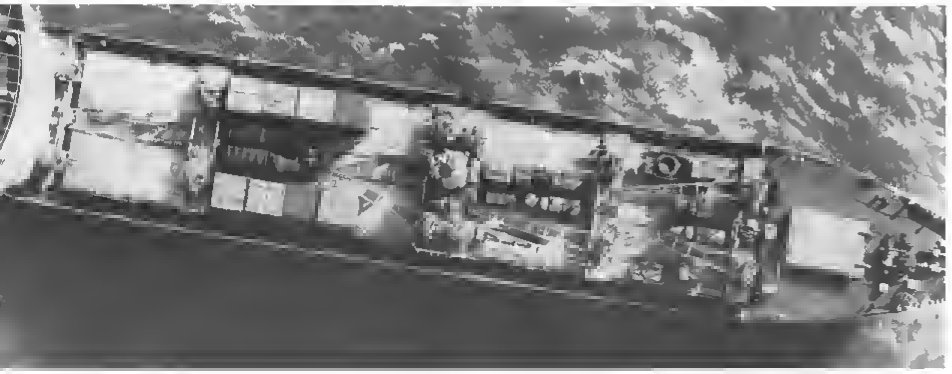


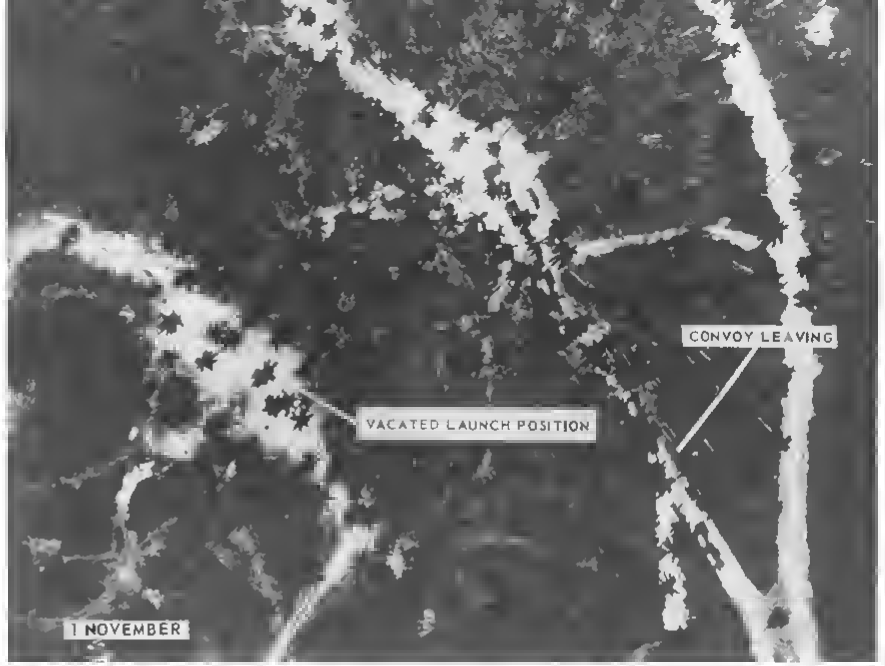
Sagua La Grande MRBM site in late October showed signs of heavy truck travel and construction, and the beginning of camouflage. Erector-launchers were in place at the launch pads, a gimbaled theodolite alignment station and cabling were evident at lower site, and a cherry picker type crane was visible at upper site. Later photo (opp. page) does not include fuel and oxidizer truck parking area.

Aerial Photos Show Missile Erector Removal At Cuban Sites

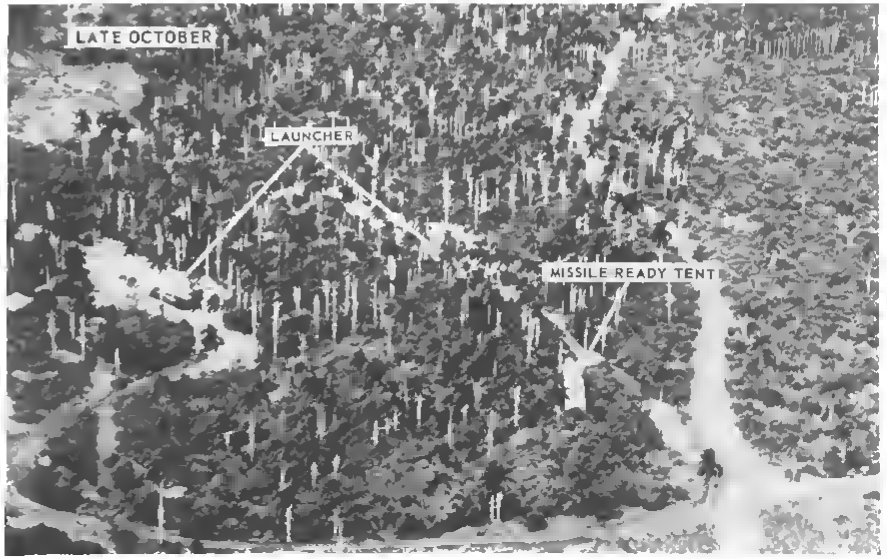
Second medium-range ballistic missile site in the San Cristobal area (above) showed removal of two launcher-erectors in the Nov. 1 photo-reconnaissance results. Missile ready tents are still in place, however, and canvas still covers an object at the lower launch position. Cables extending from it to the erector (left) and from it into the trees below have disappeared in the later photo. Parked trucks and trailers remain in open area (center). Launch position at left center (not designated as such in photo left) is the same site as that on p. 33 (top) in the Nov. 5 issue of Aviation Week and Space Technology, though photos are taken from different directions.

Deck load of the Russian cargo ship Poltava, photographed during a 180-deg turn in the English Channel Oct 30, includes 10 trucks of varying design destined but not delivered for support of Russian medium-range ballistic missile bases in Cuba Poltava returned to port rather than test the U S blockade Two trucks on forward hatch (below) have specially fitted bodies for what may be sections of a missile launcher Poltava is about 500 ft long, grosses 9,500 tons and is fitted with 12 light cranes forward and one aft, and one heavy boom amidships for rapid loading and unloading at ports without much dock equipment Exposed draft marks on bow and rudder section riding out of the water astern (top) indicate a relatively light, high volume cargo such as unfueled missiles Note oversize hatch (below), 60-70 ft long—large enough for rapid loading of assembled Shyster. Additional deck stored cargo crate and crane are visible on stern.





Departing truck convoy is indicated (above) in a Nov 1 photo of a medium-range ballistic missile site in the Sagua La Grande area A second vacated launch position is labeled Missile ready tent identified in October photo (below) is gone, and so is camouflage netting stretched over the road just to the right of the missile ready tent Included in the convoy are tank-carrying trucks as well as conventional canvas topped vehicles Missile erector launcher appears to have been removed at the position from which the convoy is departing, but palm tree shadows obscure the center of this area



U.S. Insists on Direct Inspection To Verify Cuban Missile Removal

Washington—U S was still insisting late last week on direct verification inside Cuba that Russian missiles had been removed before it would end the arms blockade or guarantee against invasion It maintained this position in spite of an agreement between Russia and the U S that allowed U S naval vessels to "contact" Soviet ships leaving Cuba in an attempt to count the number of missiles moving away from the island

Removal of Il 28 jet bombers, which had been a quarreling point in talks involving the U S , Russia and Cuba, still had not been clarified, even though the U S had made it clear to Russian negotiators that it considered the bombers among the "offensive weapons" which President Kennedy insisted were part of the U S -Soviet agreements

U S expected to encounter Soviet vessels Nov 9 for "close alongside observations" Defense Dept photos showed that "all known MRBM and IRBM bases in Cuba have been dismantled." Later photos "indicated the movement of significant items of equipment from the missile sites to port areas Still later photos give evidence that a substantial number of missile transporters have been loaded onto the main decks of certain Soviet cargo vessels and that several of these vessels have already departed Cuban ports ' the statement said

There was no evidence that Il 28s were being crated or removed U S sources said the missiles came into Cuba in the holds of special ships but would go out on the deck Russia was expected to cooperate in the alongside observation, and no boarding was expected, at least for the first few ships

Defense Dept expected to release photos showing the Soviet ships Divnogorsk, Fizik Kurchitov and the Anasov, presumably loaded and leaving, and photos taken Nov 1, 4 and 5 at the port of Mariel, near Havana showing progressive loading of the Anasov, Divnogorsk and the Dratsk

But the thorny question of inspection in Cuba, which was being opposed by Cuban Premier Fidel Castro on the grounds that the U S did not intend to honor his five counter-demands (AW Nov 5, p 37), had not been resolved After Defense Dept announced that Navy ships would contact outgoing Soviet vessels, State Dept insisted that some inspection inside Cuba was still a necessity

"In our view verification [of the removal of weapons] has to be verification on the ground," a State Dept spokesman said

Both the blockade and aerial surveillance were continuing late in the week, and USAF and Navy photo planes were being accompanied by fighters The unofficial view on the loss of a Strategic Air Command U-2 over Cuba on Oct 27 (AW Nov 5, p 38) was that Cuban troops had shot it down from high altitude, using Soviet-supplied anti-aircraft rockets U S sources believed Soviet technicians in Cuba were under the strictest orders not to take action against U S aircraft

U S military preparations continued, including the movement of 21 amphibious vessels through the Panama Canal from the Pacific into the Atlantic The canal was closed to commercial shipping for two days There were other indications of a concentration of amphibious warfare craft in the Florida area

Cuba was widely discussed in Moscow during celebrations of the 45th anniversary of the Russian revolution Most of the comments dealt with Chairman Khrushchev's role in the crisis, and all of them attributed the salvation of peace in the world to his actions

Meanwhile, Russia, Chinese and Cuban propaganda organs continued to support Castro's five demands, which include withdrawal of the U S from the Guantanamo Naval Base They also insisted that Russia had lived up to its part of the Khrushchev-Kennedy bargain by removing missiles from Cuba, but that the U S had not yet removed the blockade or guaranteed there would be no invasion of Cuba by U S forces or Cuban insurgents operating from this country

Khrushchev himself credited both sides with compromise in the Cuban crisis He said the world had come "very close, very close" to thermonuclear war

Who won and who lost?' Khrushchev said at a Moscow reception on Nov. 7. "Forget it Reason won, reason for mankind Mankind won Because if there hadn't been reason, then there might not have been this reception here tonight and there might not have been any elections in the United States

The Soviet leader said 40 missiles had been emplaced in Cuba 'We have taken our rockets out and they probably are on the way," he said Khrushchev said he "never was in favor of a summit meeting' with President Kennedy in connection with the Berlin situation or Cuba, but he said such meetings could be useful "if it is a question of peace and war, if the alternative to peace is war But at the present, there is no such necessity"

In a Red Square parade commemorating the anniversary of the revolution,

Search at Shannon

London—Aircraft bound for Cuba which land at Shannon Airport will be searched by officials of Eire's Ministry of Transport and Power Decision was made under provisions of the 1944 convention on international civil aviation (Article 35), permitting official searches of aircraft to ensure that no munitions are carried Shannon is used by Cubana and Czechoslovakian Airlines (CSA) for services between Prague and Havana

Red Cross Preparing for Soviet Ship Search

Geneva—International Committee of the Red Cross says it expects its proposed inspection of Soviet ships bound for Cuba to determine if any offensive weapons are aboard ' would be expected to continue for about one month " A committee spokesman said last week that the United Nations' request did not mention aircraft or actual visits to identified missile sites within Cuba

Spokesman said the Red Cross probably would recruit approximately 30 persons with both technical and diplomatic qualifications to carry out the task He stressed, however, that the exact types to be recruited and the place and means the inspections are to be carried out cannot be definitely established 'until we know exactly what the mission will be."

In a formal statement issued here last week the international committee noted that such inspections amounted to a "task outside the conventional and traditional scope ' of the group's "humanitarian mission ' It added, however, that "in the best interest of peace" it would undertake the mission upon the formal approval of the U S , the Soviet Union and Cuba

The committee said it had been assured through the UN that the Cuban government 'would accept such a form of control '

Statement added that the committee as such "could not assume direct responsibility for the proposed operation, which would remain within the competence of the United Nations and the states concerned The international committee's contribution would consist chiefly in recruiting personnel charged with visiting the vessels."

WARNEFORD AND GOLIATH

LEACH HERITAGE OF THE AIR—22

Twenty-year-old R A J. Warneford had never flown at night But this boy in the uniform of a Flight Sub-Lieutenant learned fast. And well.

Warneford joined the Royal Naval Air Service in 1915 By June of that year he had his wings. His big moment began at midnight June 7, at a tiny airfield near Furnes, just across the French-Belgium border His mission: to bomb the German Zeppelin sheds at Berchem St. Agathe Belgium.

The Zeppelin was considered invincible in the air. Whenever a British plane flew up to intercept one, the German commander could easily jettison his water ballast and the giant airship would shoot up thousands of feet in the air—higher than most planes at that time could fly.

The only way to destroy the Zeppelins was at their moorings. And they *had* to be destroyed London had already been attacked On May 31st, the noted Zeppelin commander Hauptmann Karl Lunarz surprised the city at night, dropped his bombs and floated back across the Channel undetected British morale was never lower. First, poison gas Now this The plane Warneford was flying was certainly no match for the hated giants in the air. But the Morane Parasol was pretty fast, by 1915 standards. Powered by a nine cylinder, 80 hp. La Rhone rotary engine, it reached 70 mph at low altitudes Its only armament was six 20-pound bombs in a makeshift bomb rack and a light carbine borrowed from the Belgian army.

Exactly at midnight, Warneford crossed his fingers and took off. He circled above Furnes waiting to be joined by others But he lost them in the blackness

So he elected to go on to Berchem St. Agatha alone. Minutes later, he saw ahead of him a dark mass and just below it blue-yellow exhaust flames As he neared the Thing, he froze at the controls He was heading straight at a Zeppelin!

Fate had brought Warneford and his slingshot face to face with a 521-foot long Goliath This particular monster—called LZ 37—had 18 main gas chambers carrying 953,000 cubic feet of hydrogen. It was powered by four new 210 hp. Mayback engines and had a crew of 28.

Warneford didn't have time to wonder at the enormity of the Thing before him. The Zeppelin's machine guns were already firing bullets through the frail wings of his Parasol. He veered off, came about, and got the second big shock of his young life. The Thing was chasing *him!*

Tracer bullets were whizzing right by Warneford's ear. He ducked and dove under the belly of the whale-like war ship Then he began popping away at the Thing with his carbine It was like shooting at an elephant with a BB gun But BBs or no, the German had enough The water ballast was dumped and the giant gas bag rose out of range.

By now it was 2 25 in the still dark morning Warneford wouldn't give up At a safe distance and climbing all the while, he followed the LZ 37 on its course to Ghent. He pulled his Parasol up to 11,000 feet. Unaware that the nagging fly was still buzzing him, the German dropped to 7,000 feet Warneford was at last *above* the bulging behemoth

Out of sight of the gondola tucked under the bulge, Warneford swooped down on his giant prey. No more than 200 feet over target, he dropped his fire bombs. Six little bombs tore into the Zeppelin's skin, And 953,000 cubic feet of hydrogen reacted with a violent and deafening explosion.

Warneford's tiny Paresol was flung from the burst as if shot from a cannon, In seconds, the invincible Zeppelin was reduced to a red hot steel shell plummeting to earth

For his brave act, King George V awarded him the Victoria Cross France gave him their highest decoration—the Cross of the Legion of Honor The British no longer feared the "invincible" Zeppelin.

But the boy David would never be 21. Ten days after his heroic kill, he died in a plane crash near Paris. Old timers in England still talk about the morning of June 7, 1915 when R A J. Warneford got his Goliath. And they speak of it with reverence.

Russia displayed for the first time a 50-ft naval rocket with what appeared to be a cluster of nozzles at the rear and a blunt nose that roughly resembled that of a Jupiter intermediate-range missile (see p. 28)

Soviet Defense Minister Marshal Rodion Malinovsky, speaking at the same ceremony, said the U S had brought the world to "the brink of thermonuclear war" with its Cuban blockade and said his forces could direct a "smashing retaliatory blow" if the West started a war But he insisted that Khrushchev's actions during the crisis were peaceful and devoted to coexistence with the West

Khrushchev also indicated there were no more ultimatums and deadlines involved in plans for Berlin I have read all about your schedules,' he told reporters "When the time is ripe, the child is born The time must be right"

Khrushchev confirmed that Russia had had trouble handling Cuba He said the U S said it would not attack Cuba so Russia removed its missiles "We assured the Cubans that we would not abandon them," he said "The Cubans said they don't believe, they don't believe And we told them in that case it would mean war But we believed the President would keep his word I want to believe him If he went back on his word that would be an unreasonable step and would put us back where we were, back to a position of catastrophe"

Despite reports from Cuban refugees that some of the missiles were being stored in caves, Asst Secretary of State for Latin American Affairs Edward M Martin said last week that 'we have no evidence as to whether or not this is being done" State's information officer, Lincoln White, said 'We have no information about any missiles or bombers or what have you being stored in caves"

White said inspection on the ground in Cuba is being insisted upon 'because this was our understanding of the agreement to begin with" Martin said inspection of vessels outbound from Cuba 'would tell us what was leaving Cuba It would not tell us what was left behind" He said the U S probably will demand 'some kind of international verification that inbound ships are not carrying new weapons to Cuba.

UN Ambassador Adlai Stevenson and other U S officials briefed NATO, SEATO and CENTO delegates on Nov 8 and informed sources said later that the presence of Il-28s and nuclear warheads in Cuba had become a key factor in the crisis UN sources said the critical stage of the Cuban situation had not diminished, and another said his impression was that "the crisis still is smouldering"

NASA-DOD Pact May Eliminate Large Solids From Role in Nova

Washington—Defense Dept and National Aeronautics and Space Administration have finally agreed on a plan to develop large solid propellant motors, but the development pace is so modest that it may remove solids as a serious competitor for the Nova booster role.

Fiscal 1963 funding for the program will be between $25 million and $32 million, with one-third to one-half of the money earmarked for advanced technology rather than motor development. Air Force is technical manager and the program has been placed under USAF Systems Command's large motor 623-A program. The agreement has a provision that NASA and Defense Dept will renegotiate management for Fiscal 1964.

Solid rocket proponents in NASA and industry had hoped to get the program under way with a feasibility demonstration contract this year. Instead, NASA's funding problems (see p. 27), and the coolness of Defense Dept toward the program (AW Oct. 1, p. 16) have combined to reduce the program to the lowest-priced and slowest-paced of four alternate plans under consideration.

Most ambitious of the four alternatives was a 24-month, $250 million feasibility demonstration program, which would have included a new plant, new test facilities and static tests of flight-weight hardware and flight components. The agreement, which is called Alternate 1, probably will call for construction of a small water-side test facility and static tests of two half-length 260-in. motors.

Air Force, however, may press for testing a full size 156-in. dia. motor because one of its Edwards AFB test stands, being built for the Titan 3 120-in. dia. solid, can accommodate the larger motor.

In any event, the development plan will call for advanced studies on propellants, ignition systems, vehicle configuration and vehicle materials. Space Systems Division's facility at Edwards is also developing a movable nozzle for solid vehicles with a 10-in. throat dia. Minuteman movable nozzles are 7.75 in. dia. Edwards is preparing specifications for a re-usable 10-ft. long rocket casing on which the nozzle will be tested.

Original set of specifications which was prepared five months ago, was for a full-length vehicle and USAF anticipates that they can be revised by the end of this week. Approval then must be obtained from USAF Headquarters and Defense Dept., with concurrence from NASA. When this is completed proposal requests could go to industry within 10 days.

Two contracts probably will be awarded, one this fiscal year and one in Fiscal 1965.

One competitor said first firing of a 156-in.-dia. motor could take place as early as next March, but facilities at Edwards will not be ready for test until next fall, and it is anticipated that the Titan 3 program will be given top scheduling priority.

U. S. Mars Probe

Los Angeles—United States will not launch a Mars spacecraft comparable in size and weight to the one-ton Russian Mars 1 before late 1966.

Delays in development of its Atlas-Centaur launch vehicle have disrupted National Aeronautics and Space Administration plans to fire a pair of 1,200-1,700 lb. Mariner B spacecraft in quick succession at the next Mars planetary opportunity, which occurs in 25 month cycles, in mid-1964.

Limited capability, lightweight spacecraft called Mariner M is now under development at Jet Propulsion Laboratory and is expected to be authorized by NASA as a substitute for the 1964 opportunity. Mariner M (AW July 16, p. 32) probably will use an Atlas-Agena B booster and may scale 500 or 600 lb.

This project change will push Mariner B back 25 months to the next Mars opportunity in December 1966. A space test firing and a Venus flyby attempt probably will be made with this type of vehicle in 1965.

IMCC Procurement

Representatives from 50 aerospace companies were briefed on Nov. 2 by North American Space & Information Systems Division about an impending procurement for the mission simulator to be incorporated into the Manned Spacecraft Center Integrated Mission Control Center (AW Oct. 22, p. 26; Sept. 24, p. 41).

Simulators, one of which will be located in Houston, the other at Cape Canaveral, will serve as a training device for Apollo and Gemini astronauts and will function as a checkout system for the entire IMCC and the Apollo life support system.

Proposal requests will be issued in December. Industry replies probably will be scheduled for submission the following month with work scheduled to start by Mar. 1.

At least $10 million is reported to be available for the simulator fabrication. Bidders probably will include General Precision, Philco, Bendix, IBM, Raytheon and Sperry Rand.

IBM recently was picked to supply the data processing complex for IMCC and proposal requests for the IMCC integration responsibility from Manned Spacecraft Center are expected momentarily (see p. 23).

Soviets Seek Mars Pass Within 620 mi.

Moscow—Russian Mars 1 interplanetary probe may pass within 620 mi. of the planet Mars after a mid-course maneuver to be made on an unspecified date, according to the Soviet news agency Tass.

Tass said that if the payload maintains its present course without a correction, the miss distance will be about 156,000 mi. After seven days of flight, USSR said the spacecraft was functioning normally and was at a distance of approximately 1.6 million mi. from the earth.

The news agency also said that on Nov. 2, the day after launch (AW Nov. 5, p. 43), Soviet astronomical observatories photographed the probe against the star background and it appeared as a star of the fourteenth magnitude.

In the U. S., meanwhile, observers say the Mars 1 mission could have been accomplished with the same basic 700,000-800,000 lb. thrust booster that USSR has used for its large payloads in the past. The probe is viewed as a spacecraft accomplishment rather than an advance in launch vehicle technology because it involves either the same restart technique U. S. has used several times, or else a fourth stage on the same type vehicle which launched the manned Vostok satellites.

The 1,965 lb. Mars 1 payload was launched from a parking orbit. This is the first time the Russians have said they used this technique for an escape trajectory injection.

Flight to Mars is expected to last about seven months. The Martian photography experiment apparently is designed to store pictures taken during the encounter, and then to transmit them when the payload approaches earth on its heliocentric orbit.

Probe experiments are powered by a system of solar panels and batteries. In addition to planetary photography, experiments are prolonged exploration of interplanetary space and long range communications.

Transmission frequencies are 922.76 mc. and 183.6 mc.

Balzac VTOL Ends Initial Free Flight Test Phase

Dassault Balzac VTOL testbed has successfully completed its initial free flight test phase which included 20 min. of flight time in hovering altitudes up to several hundred feet. Tethered flights were run off Oct. 12-15 (above). First free flight was made Nov. 6. Initial VTOL flights of the aircraft, powered by eight Rolls-Royce RB 108 lift thrust engines are now terminated and the testbed version of the Mirage 3 V will begin conventional flight portion of its test program shortly. Initial free flight testing was designed primarily to check out Balzac's bleed-air roll, pitch and yaw stabilization systems during minimal speed ranges in VTOL regime (AW Aug. 10, p. 30).

Boeing, Union Agree To Union Shop Poll

Washington — Threatened strike against Boeing Co. was averted last week by an agreement between the company and the International Assn. of Machinists, CIO-AFL, to poll employes on the union shop issue the first week of December.

The poll, announced by President Kennedy, was reluctantly agreed to by the company, which noted that "the result will not be binding on either the company or the union." It will be conducted by the National Labor Relations Board and will be advisory to the special board established by the President to facilitate settlement of a labor contract. The union shop issue has been the main stumbling block.

Workers in recent elections at North American Aviation, Inc., and the Convair Division of General Dynamics Corp. failed to give the union shop the required two-thirds support (AW Nov. 5, p. 43). North American is organized by United Automobile Workers, CIO-AFL, and Convair by IAM.

Boeing Co. said that it intends "to state fully to its employes" its reasons for opposition to the union shop.

In other labor developments, Ryan Aeronautical Co. employes failed to give a proposal for a union shop the necessary two-thirds majority in an election held Nov. 1. Only 60% of 1,377 employes voting in a special election approved the measure, despite the fact that over 83% of its employes in the bargaining unit are members of the UAW, according to Ryan.

Meanwhile, IAM gave its 2,500-man Azusa local permission to sign a separate contract with Aerojet-General Corp. after a split developed between the Sacramento and Azusa IAM locals over approval of a new company contract offer. Sacramento local rejected the offer, Azusa approved it.

News Digest

Federal Aviation Agency last week sent letters to 13 Eastern Air Lines' pilots charging them with inattention to pilot duties. The action came as a result of photographs taken by a former Eastern flight engineer (AW Oct. 8, p. 42). Possible penalties mentioned in the letters are fines of $300 to $600. Crew members have 10 days in which to reply. FAA also told Eastern that in the future, both pilots and management will be held responsible for lax cockpit discipline. Earlier, Eastern had temporarily grounded three captains on similar charges growing out of the same photos.

Justice Dept. has filed an anti-trust suit against General Dynamics Corp., asking that the company divest itself of the Liquid Carbonic Division. The government says General Dynamics used its purchasing power to force other firms which sell to it to buy General Dynamics' carbon dioxide.

Col. George M. Knauf, deputy director of space medicine in National Aeronautics and Space Administration's Manned Space Flight Office, has retired from the Air Force and will retain the position as a civilian. He had been detailed to NASA since January.

Col. Peter Ivanovich Dolgov, who helped develop the pilot ejection device for Soviet Vostoks, was killed recently "while fulfilling his duties," Russia's military newspaper Red Star said. Dolgov was a leading tester of parachutes and ejection seats and the holder of eight Soviet and world parachute jumping records.

NASA has divided its center-head quarters reporting structure into manned space flight and operations other than manned flight, with Brainerd Holmes and Thomas F. Dixon, deputy associate administrators responsible for the two broad programs. Holmes will retain his job as director of manned flight.

Rocketdyne Division of North American Aviation, Inc., will provide the prepackaged liquid fuel propulsion system for Army's Missile B. AVIATION WEEK reported incorrectly that Aerojet-General would be the propulsion contractor (AW Nov. 5, p. 25).

Long-Standing IATA Problems Resolved

Basic efficiency of international airline group is demonstrated by settlement of five major controversies.

By L. L. Doty

Washington—Recent International Air Transport Assn traffic conferences resolved several long-standing controversies, providing fresh hope that the industry's net loss in 1961 may be translated into a net gain next year.

Agreement on at least five major problems that once seemed beyond settlement demonstrates that the IATA machinery can function efficiently if the right strategy is used. It is significant that the rule of unanimity, once considered IATA's chief weakness, proved to be a major strong point in arresting costly airline abuses and violations of tariff regulations.

Here are the principal problems, other than those on general fares and rates, on which agreement was reached at the traffic conferences at Chandler, Ariz. (AW Nov. 5, p. 44):

• **Resolution 014A,** which sets rates for excess mileage on a given route, has been a source of discord for about 10 years. Some airlines have misapplied the resolution by offering excessive circuitous routings and even extra side trips at only a slight increase over regular round-trip rates. Passengers purchasing such tickets thus receive passage at a rate per mile substantially less than standards used for normal fare construction. Last year, this practice is estimated to have cost the industry over $140 million in revenues, equivalent to its net loss for that year. Agreement on a new fare table to cover offline travel will sharply abate these abuses.

• **Charter regulations** have been severely tightened in a move to retard the steady drain of regular traffic to the lower yield charter services. In addition, spontaneous groups will no longer qualify for charter flights. Groups must now prove some affinity, such as club membership over a specified period of time or direct association with a company, association or established social unit. The same requirement also applies to group fares in international travel (AW Oct. 22, p. 36).

• **Tendency of some carriers** to seek directives from their governments ordering transportation of certain categories of commercial traffic at rates below IATA levels has been the target of much criticism in the industry. The practice is considered legal in the movement of government or military personnel, but it has been interpreted as a violation of IATA regulations when expanded to embrace strictly commercial traffic. Under a new resolution adopted at the Chandler conferences, any carrier suspecting another airline of taking excessive advantage of this provision can declare an open rate situation on the route or routes in question.

• **Practice by some freight consolidators** of shifting their responsibilities for packaging, airway billing or sorting to the airlines has substantially increased handling costs. Because of the marginal profit of the cargo business, these costs have proven dangerously high. In a number of world areas, freight consolidators have been operating without any controlling regulation, and often without a requirement for accounting of shipments. Under a new resolution, direct responsibilities will be assigned freight consolidators which must be undertaken before their shipments will be accepted. In addition, consolidators must be registered agents and must conform to established regulations.

• **In a move to bring non-IATA** carrier rates up to IATA standards, thus reducing the volume of competitive price-cutting, it was agreed at the Chandler conferences that no interline agreement between an IATA and non-IATA carrier can be effective unless the latter charges IATA rates. Chief difficulty in reaching agreement on this issue was that many IATA carriers own subsidiary airlines in many parts of the world which are not IATA carriers and do not conform to IATA rate regulations. Advantages to the parent company are obvious, and this resolution was passed after a great many protests were overcome.

In addition to the above problems, several other, relatively new ones were solved.

Chief among these was the "malpractice" resolution, first disclosed by Aviation Week (AW Oct. 22, p. 36), which is designed primarily to prevent price cutting by IATA member carriers through the use of under-the-table discounts.

A second problem resolved was that pertaining to the payment of passenger expenses incurred as a result of unscheduled stopovers, delays or flight cancellations. Although this practice is legal and will continue, the resolution covering it was tightened to prevent carriers from advertising and promoting such expense coverage as part of a package tour.

For example, several carriers in recent years have been advertising the availability of stopovers en route at attractive locales with all sightseeing costs covered by the airline. One carrier promotes a 24-hr. stopover on its transpacific route at Tahiti with food, lodging, sightseeing and a free side flight to neighboring Bora Bora at no expense to the passenger.

Such practice has not been considered illegal in the past, since the original resolution was adopted at a time when aircraft were limited in range, night flying on overseas routes was impractical and weather and mechanical delays were commonplace. By modernizing this resolution, carriers now will be permitted to cover expenses only when the passenger is inconvenienced by a change in flight schedule that is beyond his or the airline's control.

Resolution 014A was the most difficult of all problems to resolve, since many carriers depended on the original fare construction formula it contained to attract and sell passenger traffic. It was an issue that has been raised in every traffic conference during the past 10 years without coming close to a settlement.

A study of the resolution was undertaken in 1956, but no solution acceptable to all airlines was found. Several years later, another detailed survey was made, but the conclusions were again rejected by an adamant core of carriers.

The battle was waged between a group of conservative carriers who wanted protection and considered application of the resolution an unfair trade practice, and a group whose very existence depended upon its continued use. The latter felt that any revision in the resolution would be tantamount to economic suicide.

How agreement was reached this year is a revealing demonstration of the basic soundness of the IATA machinery, if all its segments are brought into action, and how important the veto right is in making any agreement effective.

It must be admitted that particular attention was focused on Resolution 014A this year because of the dismal financial results reported in 1961. But despite the reasons that prompted action on the issue, solution of the problem came about primarily because top level management of the industry put the entire IATA machinery in motion.

First step was the circulation early last year of a questionnaire consisting of 60 questions pertaining to the resolution. Proposals received in response to the questionnaire were collated and used as the basis of the agenda of a special meeting of airline vice presidents in Paris in early April. This conference produced a refined analysis of the subject, which was turned over to industry tariff technicians who were instructed to develop a new resolution formula.

Unfortunately, this group's efforts ended in stalemate, primarily because a number of delegates were stifled by company policies which deprived them of the necessary flexibility for full bargaining and negotiating.

This failure brought the Traffic Advisory Committee into the picture, and the issue was then presented to the IATA Executive Committee. Consequently, Resolution 014A became one of the leading subjects of the IATA Annual General Meeting in Dublin (AW Sept. 10, p. 36).

Thus, all levels of management and industry staff became engaged in resolving the issue. The net effect was to grant technicians more flexibility in formulating a revised fare table.

To take full advantage of this newly applied privilege, the Traffic Advisory Committee formed a subcommittee of eight officials to work in close cooperation with the technicians during the Chandler conference. Views were exchanged readily between the two groups, and deadlocks were quickly broken because of the freer range of operation granted the technicians and the accessibility of the policy-making subcommittee.

This free exchange of information and advice gradually evolved into a working formula during the closing days of the conferences. The final document, when presented to the conference, was approved unanimously in less than 10 min.

Under the old formula contained in the resolution, carriers were required to add 2½% of the basic fare between two points when mileage exceeded 15% of the direct mileage on the route. This additional charge was graduated up to a maximum of 12½%.

Since there were no limitations on the mileage that could be granted a passenger once he had paid the additional 12½% on the basic round trip fare, many carriers lured traffic their way by tacking unlimited extensive circuitous routings and even sidetrips on the regular ticket at no further cost. Such practice has been termed "give-away mileage."

Carriers opposed to the practice were forced to adopt it for competitive reasons, and for at least 10 years, it was a commonly accepted method of constructing fares. During this period, passengers could travel a wide range of routes, visit innumerable cities en route by merely paying 12½% over the regular cost of a round trip ticket. Seat mile revenue on such tickets fell far below the level considered a break-even point.

Under the revised fare construction there will be no charge for additional mileage totaling up to 20% of the direct mileage between two points. But above that level additional charges will be graduated from 5% of the basic tariff up to as high as 25% of the fare when additional mileage reaches 50% of the direct mileage.

Beyond 50%, carriers will be required to construct fares on the basis of the sum of the fares of all sectors included in the itinerary. Thus, a ceiling is placed on the amount of additional mileage that can be granted without additional cost to the passenger.

Amery Keeps BOAC-BEA Merger Possibility Alive Until Probe Ends

By Herbert J. Coleman

London—Minister of Aviation Julian Amery last week left the door open to discussions of an eventual merger of the two state-owned airlines, British Overseas Airways Corp. and British European Airways, a move which has been strenuously opposed by top management of both BOAC and BEA.

He told the House of Commons, during debate of a bill to extend borrowing powers of the airlines, that the question of merger was one of many airline problems he wished to explore, but not until a report by John Corbett, certified public accountant, into BOAC finances (AW Nov. 5, p. 52), was presented to the Ministry next spring.

The bill before the house will increase borrowing powers of BOAC from $505 million to $840 million, primarily to finance new aircraft (AW Oct. 22, p. 40).

In addition, the bill includes provision for BEA to raise borrowing powers from $266 million to $350 million.

Amery, however, stressed that the bill is regarded by the British government as a short-term remedial measure intended to tide the corporations over their immediate difficulties. The bill will be applicable to April, 1964.

Amery, in a reference to BOAC's losses (AW Oct. 15, p. 38), said he could not criticize the airline's operating and safety standards and added that the leadership of Sir Matthew Slattery, chairman, had been in the tradition of "our service commanders-in-chief."

The minister continued:

"But if the professional record of the corporation was proved, the commercial side of the picture was much more somber. The over-all deficit amounts to $180.8 million of which $140 million arises in the accounts for last year. Frankly, this is pretty steep and calls for a searching inquiry."

Amery also said he could not condemn BOAC's decision to buy the de Havilland Comet or Bristol Britannia, noting that the national interest is best served by close partnership with the British aviation industry. But he countered that he could not accept that the depreciation of value of the corporation's air fleet had been only revealed this year. This was a situation that had built up over some years.

Amery explained that Slattery had suggested that the past losses should be written off to save interest charges but the minister said he could not see that BOAC should be specially exempted from servicing of its borrowed capital.

"We all want to see BOAC make a reasonable return on capital," he explained. "This may call for major changes in policy or management, but it will be neither helped nor hindered by bookkeeping."

The minister said BOAC's prospects for 1962-63 are not bright, although the corporation expected to make a smaller loss than last year. Questions on BOAC currently facing the government, he went on, are:

• **How far is BOAC management** to be held responsible for losses on the operating account?

• **How much of the loss** has arisen from factors outside their control?

• **Could management** be expected to foresee the decline in traffic growth and could they have ensured against it if they had foreseen it?

• **Is BOAC operating too many** routes and are the sales operations for these sufficient?

• **How does BOAC's performance** compare with its competitors?

Amery said BEA now expects that its loss for the 1962-63 year will be $11.2 million. Until last year, BEA had made a profit for seven consecutive years (AW Sept. 3, p. 30).

Airline Interest Veers to Plane Mile Cost

By James R Ashlock

New York—Seat mile costs appear to be losing some of their appeal among airline equipment planners as a yardstick of aircraft earning capacity, and more attention is being directed toward plane mile costs

Attitude is especially apparent in discussions about the short-haul jet transport, but also may affect airline views on any aircraft that manufacturers propose for the next major round of orders.

Seat mile costs are the traditional formula for determining an aircraft's earning power Break-even load factors are estimated by dividing seat capacity into total operating costs. This approach made present jets very attractive, from the seat mile cost standpoint, compared with the smaller piston transports

Short-Haul Factors

Plane mile costs, however, concern only the actual operating cost of the aircraft

And airline engineers insist that in a short-haul operation, where load factors will be low and erratic, plane mile costs must be held to an absolute minimum

"You must remember that seat mile costs mean very little unless there are people sitting in the seats," said an official of one of the Big Four domestic trunk carriers

Airline officials generally agree now that more attention should have been given during design to lowering plane mile costs on current jets, since the great increase in capacity and steadily rising operating costs have eroded some of the jets' low seat mile cost advantage

Feeling is widespread that in designing an aircraft for the short-range market, manufacturers should concentrate on minimum operating costs and reliability of high-frequency utilization High speed and capacity, the factors which dictate seat mile costs, are being de emphasized

"The man selling short haul jets is finding us more cold-blooded than we've been in the past," said one airline official

Airline engineers say the short haul jet must not undergo the phenomenon whereby aircraft "grow on the drawing boards."

This situation developed with current jets when range and weight increases were offset by an expansion of capacity, thus maintaining the originally established seat mile costs

While certain carriers today are unhappy that this happened, they don't blame the manufacturers altogether Most airline officials remember that they gladly accepted the seat additions, confident that cost of the extra capacity would be justified in peak travel periods

Buyers' specifications for range, strength and components, plus the Federal Aviation Agency's requirements for safety features, often push an aircraft's weight above the original design limit An example is the Boeing 727, which at 152,000 lb. gross is substantially heavier than first proposed

Airline engineers are insisting now, however, that aircraft be tailored for specific service, a request posing greater challenges to designers and manufacturers

Growing demand for lower plane mile costs is evident in a speech made before an engineering group recently by Russel K Rourke, a vice president of Trans World Airlines

Rourke said that in view of conditions today, the airlines perhaps would have been wiser to demand that the original jet transports provide only a moderate increase in capacity over DC 7s and Lockheed Super-Constellations ' Their size could have then been increased on a more equal scale with market expansion," he said

Cost Reduction

"To achieve reasonable unit cost under these circumstances, the designer certainly would have had a greater challenge in finding ways to reduce costs—not only those of manufacturing and designing but in-flight operating costs as well," Rourke says

"Perhaps we might have found that greater emphasis should have been given to reliability, long life and minimum overhaul costs Perhaps we might have found also that minimum cost speed should have been lower

"Also, the manufacturer might have found that his greatest opportunity to achieve economy would be through simplicity rather than an excess amount of complexity We engineers have a fault in that in our desire to advance technical things we climb mounts just because they are there," Rourke continues

"Although you [the manufacturers] may not like to admit this, it is probable that market conditions and the competitive service existing had very little to do with defining the precise payload volume built into our aircraft," he says

On the other hand, W C Mentzer, senior vice president of engineering and maintenance for United Air Lines, says the number of jets placed in service has generated the revenue problem The aircraft's original size and operating costs were good and justified their purchase, he says

"I think that if we were considering a long or medium haul transport today we'd still evaluate it according to seat mile costs," Mentzer said "But this doesn't apply so much with the short haul aircraft "

Mentzer said that when United bought its twin-engine Convair 340s for shorter route service, plane mile cost was the main consideration. TWA first sought to obtain a specific-service jet in the Convair 880, seeking speed and high-frequency utilization that give it a competitive edge in medium-range markets

Even though the 880 grew to a larger size than TWA originally desired, its improving reliability and high-frequency operation today places its plane mile cost below that of TWA's Boeings, even though the Boeings' seat mile cost is still lower

Concern over costs is also stimulated by the realization that any jets the airlines now have or may buy must be used for a long period Mentzer sees nothing on the horizon now for passenger transports except the short-haul and supersonic potential

'Even if a supersonic transport does enter service in the 1970s, its only impact will be in the long haul market"

Confidence that present jets will be in use for a long time is indicated in United's recent extension of depreciation on its DC-8s and Boeings to 14 years, residual value at that time to be $100,000

Other carrier spokesmen share United's opinion about lengths reliance on present jets well beyond supersonic transport availability And since need for a short haul jet is more immediate, some manufacturers are concentrating on it to a greater degree However, the only proposal to stir favorable comment has been the BAC 111, and several carriers say even it doesn't fill their need

"There is a general change of thinking under way," said Frank W. Kolk, assistant vice president of engineering research and development for American Airlines

Kolk's ideas about a short-haul aircraft indicate that economy—not speed or complex designs for outstanding performance—is the dominant requirement

"For instance, I'd like to see the airplane have an engine that you can install and not have to take off again during the overhaul life of the airframe," Kolk says "I am convinced that such an engine can be built"

Availability of suitable powerplants is perhaps the greatest item handicapping development of a suitable short-haul jet The Pratt & Whitney JT8 with 14,000 lb of thrust and 2,994 lb dry weight is considered too large, while the JTF-10, with 10,000 lb thrust, is felt to be too small

"What we need is a new engine—one that provides high economy rather than high speed " says Charles Froesch, vice president of engineering for Eastern "We could probably use one that even had a 2 or 3-to-1 fan size ratio."

Rourke feels that the JTF-10 is perhaps acceptable for a short-haul jet, so far as its 10,000-lb thrust capability is concerned Although this would require holding capacity to about 50 seats, Rourke believes such payload is more realistic for short haul than the often expressed 60-80 seats.

However, engineers emphasize that present small engines are miniaturizations of larger powerplants, and they question whether they would provide the desired improvement in economy and overhaul life for short-haul operations

Much thinking about economy arose out of airline participation in the design of the Boeing 727 Some engineers feel the transport has been allowed to grow

Intra-European Traffic—Air Research Bureau Member Carriers*

August, 1962

	Passenger Traffic			Freight Traffic Ton Miles (000)		
	Seat Miles (Million)	Passenger Miles (Million)	Passenger Load Factor (%)	Passenger Services	Freight Services	Total
August						
1961	884 92	518 64	58 5	4,391 53	2,993 45	7,384 98
1962 (Provisional)	948 82	562 94	59 3	4,421 67	1,474 12	5,895 79
July						
1961	864 93	505 12	58 4	4,427 84	2,368 73	6,796 57
1962 (Revised)	951 25	554 86	58.3	4,877 26	1,789 22	6,666 42
12 Months from August to July Inclusive						
1961	7,707 29	4,249 63	55 0	51,851 76	18,773 79	70,625 55
1962	8,639 48	4,696 26	54 4	55,638.44	25.829 98	81,468 42

* Figures compiled by the Air Research Bureau from reports filed by Aer Lingus, Air France, Alitalia, SEA, BOAC, Lufthansa, Finnair, Iberia, Icelandair, KLM, Olympic, SAS Sabena, Swissair and, for passenger traffic only, TAP Portuguese Airline Intra-European traffic is defined as that carried on international routes originating and terminating within the geographical area covered by the European continent and countries bordering the Mediterranean

Fifth New York Airways Vertol 107 Undergoes Flight Testing

Fifth New York Airways Vertol 107, equipped with engine inlet screens, is undergoing flight testing at Vertol's flight test facilities at Philadelphia International Airport. Fourth New York Airways ship is near completion. The airline plans to proceed with delivery of both aircraft, although Civil Aeronautics Board approval is required for the fifth helicopter purchase. Icing tests are under way at Vertol facilities in Canada on the inlet screens and indications are of satisfactory performance down to the mid —30F temperature range as long as temperature and dew point are separated more than 2 deg. Anti-icing measures under study include the use of a liquid deicer and cutting out a section of the screen at the rear, leaving the forward part of the screen for protection against foreign objects but retaining a large enough aperture at the rear for breathing without the icing complication presented by the mesh

too large for the market it will serve, and that some of the old high-cost errors of complexity and excessive operating costs may have been repeated.

"Frankly, I would have liked a larger, less complex wing than has been incorporated on the 727," says Froesch, expressing concern over added maintenance costs on the aircraft's extensive flap arrangement.

Cruising Speed

The difference in cruising speed at optimum altitude may be in the order of 25 mph higher for the smaller wing, but the block speed difference will be but 6-8 mph on a route system averaging 100-120 mi. between stops," according to Froesch.

"In the sophisticated wing case, its original cost would be, roughly, 100% greater, including cost of certification," Froesch says. "If we assume that the cost of the wing assembly is 20% of the aircraft, which for the sake of analysis is $2 million we have a wing cost of $400,000 for the sophisticated wing against $300,000 for the simpler design."

American 727 Use

Kolk, on the other hand, says that the 727 is not a short-haul aircraft and was never intended as such.

"The 727 will be a good airplane, one designed for medium range service, and American will use it as such on 300-800 mi. segments," according to Kolk.

Kolk is one of the major exponents of the 727's variable wing, favoring the smoother ride a small wing provides at low altitude and the faster climb and low-speed stability afforded by the flap arrangement.

While airline specifications accounted for the 727's weight growth, its gross might have been even higher had the self-contained ground deicing equipment advocated by Eastern and the boundary layer control desired by American Airlines been built into it.

However, airline engineers seem allied for the present in a stand that the short-haul transport must be designed specifically for its market, and that it cannot be allowed to grow out of proportion.

Seat Mile Cost

Many of us will recall that the early Boeing airplanes were offered with shorter fuselages than those the airlines are now operating," Rourke says. "We added 120 in. to the fuselage to further reduce seat mile cost.

"At the moment, however, we are in a period where saving the added operating expense caused by the extra fuselage length might have more value on a short-term basis than the extra seats made possible by the extension."

United's quest for specifically tailored aircraft is responsible for it having DC-8s, Boeings and Caravelles in its fleet today, and for its 727 orders.

"But we've gone by the initial blush of jet acquisition," said one United spokesman. "I don't think we'll be buying airplanes now that just sort of fit our needs."

Rourke likens the airlines' early jet purchases to buying "a size 42 suit to fit a size 40 body." This resulted from optimism of rapid passenger volume growth and good return due to the low seat mile costs.

"Obviously, if any of us were able to redesign our fleet structure, each airline, I am sure, would postulate a fleet quite different from that which it procured during early jet contract signing," Rourke says.

"I am sure TWA's fleet would consist of something like 320Bs, 120Bs, 727s and a smaller airplane, such as the Douglas 2086 or BAC 111."

LOT Viscount Service

Geneva—LOT Polish Airlines plans to introduce Vickers Viscount service from Warsaw to Cairo via Vienna and Athens next April.

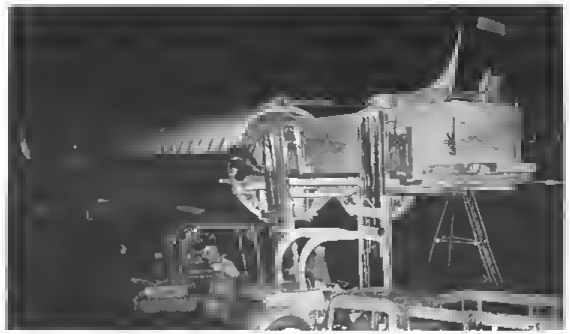
Depending on the successful conclusion of current negotiations, the new route probably also will be extended to India if landing rights at interim points including Iraq and the Lebanon are granted.

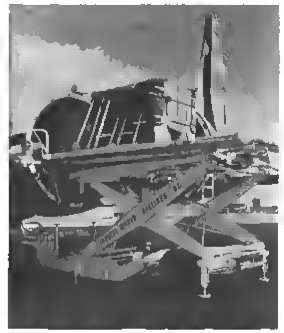
Delivery of the first of three Vickers Viscount series 800 turboprop transports ordered from British Aircraft Corp. in June will begin soon, and LOT says it also plans to operate the aircraft on new services to London and Paris beginning next spring.

Frequency over the new routes has not yet been determined.

First Boeing 727 Enters Final Assembly

First Boeing 727 three engine airliner has moved onto the final assembly line at Boeing's Renton, Wash. factory and center engine has been installed. Horizontal stabilizer has been added to top of the fin and podded engines are due to be mated to side of fuselage soon. Roll out is scheduled for late November and first flight is planned for early 1963.





CARGO CAPACITY of Seaboard World CL-44 is demonstrated in loading of a seven-ton ice cream plant measuring 28½ ft. long, 6 ft. wide and 5 ft. high (left). Special high capacity hydraulic lift and conveyor system is used to load a 97,000-lb. IBM computer shipment on the CL-44. Airline operates a fleet of seven CL-44s, and currently is experiencing its first profit in four years.

Seaboard Sales Approach Exploits CL-44

Washington—Seaboard World Airlines is relying on a broad scale expansion of volume shipping to fill the holds of its seven Canadair CL-44 aircraft now facing increased competition across the Atlantic.

Seaboard is firmly committed to a long-range sales program designed to attract high volume cargo, and currently claims a 40% share of the Atlantic all-cargo market. However, the airline anticipates that its turboprop fleet faces more intensive competition from a new generation of turbojet airfreighters such as Boeing 707-320C aircraft ordered by Pan American World Airways.

Rapid expansion of its "blocked space" plan, under which Seaboard World has been providing an advance lease of CL-44 cargo space to the German airline Lufthansa on westbound Atlantic flights, is certain to be a major part of the company's commercial sales campaign in Europe. Four other European carriers are currently negotiating with Seaboard for a similar lease agreement, and it is expected that a firm contract will be signed by at least one within a few days.

Seaboard is currently enjoying its first profits in four years under President Richard M. Jackson, and the CL-44 re-equipment program, which brought with it an immediate need for new sales concepts to feature the aircraft's capacity potential.

"Our problem was how to take advantage of its large-scale potentials for profit, and not fall victims to its large-scale potential for loss," Jackson said.

Profit impact exerted by the CL-44 swingtail and its specifically designed sales support is indicated by recent figures, which show that this August, the airline's fleet carried a record 3,798,000 pounds of cargo, plus 10,492 passengers across the Atlantic. In August of 1961, Seaboard was operating nine Constellations—which have since been retired—and only one CL-44, and carried 2,206,927 lb. of cargo and 12,975 passengers over the same route.

Profits this August totaled $382,000, compared with an August, 1961, loss of $336,000. The tonnage and profit gains are considered particularly significant because revenue miles flown during August, 1962, were down 169,042 mi. and revenue hours were down 1,033 hr. over totals recorded during 1961.

Heavy lift potential of the CL-44 made it apparent from the start that traditional sales promotion would have to be discarded, Jackson said. A new concept of attracting volume shippers was instituted under John H. Mahoney, senior vice president-sales and board member.

With a force of nine salesmen in the U.S., three in France, eight in Germany, seven in the United Kingdom and one in Ireland, the airline began to implement a new sales and marketing program along these general guidelines:

- **Total distribution concept,** aimed at top management, to sell the CL-44 as an integral part of the manufacturing and distribution process.
- **Industrial type sales** concentrated on a market of selected customers, rather than the usual broad scale consumer type selling.
- **Careful coordination** of traffic management and sales to attain the best possible round-trip load factors.
- **Low incentive rates** to attract large volume shipments. Because of the lower cost of handling volume shipments, Mahoney has encouraged his sales staff to concentrate on this market, and has also encouraged freight forwarders and cargo agents to build more volume by consolidating shipments.

Among the unusual high-volume cargo shipments handled by Seaboard recently are an uncrated 136-piece, 97,000-lb. IBM computer and a 14,000-lb. ice cream plant, loaded as one piece.

Military traffic remains the airline's revenue backbone, but Seaboard expects to increase its percentage of commercial airfreight revenues to a point

Red China Caravelle

Paris—Red Chinese aviation officials continue to show interest in Sud Aviation's Caravelle jetliner.

Five-man delegation, headed by Red Chinese civil aviation official, Shea-Tu, recently completed a visit to Sud's main Caravelle production plant at Toulouse. Last year, during a Caravelle sales tour in the Far East, Red Chinese officials studied the Caravelle while it was at Hong Kong.

U.S. State Dept., because of U.S. equipment on the Caravelle at that time refused permission for Sud to fly the Caravelle into Red China.

Red Chinese currently operate Viscounts and Soviet Il-18 turboprops. Reportedly, Chinese are not enthusiastic about the Soviet Tu-104 pure jet aircraft which Moscow is offering them.

Sud officials were reluctant to comment on the Red Chinese visit to Toulouse. It is certain that if the Chinese bought advanced versions of the Caravelle, these aircraft would not be equipped with advanced U.S. instrumentation or powerplants.

where it will primarily carry commercial traffic.

However, Jackson believes that military traffic can serve as a "catalyst" to develop the international commercial airfreight market, and has convinced the military that it can get more frequent service by contracting for partial plane load carriage on Seaboard's regularly scheduled services, rather than contracting for planeload charter air freight flights.

USAF Contractor

The company today is the largest Air Force contractor for carriage of "Category A" cargo, the less-than-planeload military cargo on commercial flights.

Passenger and cargo rate reductions are still a problem which Seaboard feels must be solved before the maximum profit potential of the CL-44 can be realized. The airline failed to gain Civil Aeronautics Board approval more than a year ago of a plan under which passengers would be boarded, at low fares, on a standby basis on regular cargo flights.

While it is now using faster and larger aircraft, Seaboard's participation in U.S. airmail carriage has not been increased by the Post Office Department, and the International Air Transport Assn. has refused to approve any lowering of Atlantic cargo rates based upon the economies of the CL-44.

On the basis of a full year's operation, Seaboard credits much of its recent success to the CL-44s, which now deliver a direct operating cost of about five cents per available ton mile for the 32-ton payload aircraft.

Initial operations with the four-engine turboprop encountered break-in problems which caused cancellation of 20 scheduled trips during the first four months of operation. In the following 10 months, through September, 1962, only one trip was canceled.

Early Difficulties

Early operational difficulties with the Rolls-Royce Tyne engines included a cracking of flame tubes and failure of compressor bearings. Improved flame tubes were installed and mounting of the bearings was modified by the manufacturer.

Rolls provided spare engines to Seaboard at no cost and later provided additional engines at its own expense to meet the customer's need for spares.

Overhaul time on Seaboard's Tyne engines has increased from 400 hr. to 1,400 hr.

A modified block overhaul system is used on the CL-44 airframe, and the entire airframe and components are overhauled every 13,500 hr., in increments of five 2,700-hr. periods, which in turn are composed of 12 periods of 225 hr. each.

The aircraft also receives maintenance after each trip from New York to Europe and return, a round trip of approximately 25 hr. flight time.

During the initial operation of the CL-44, Canadair selected the 10 most pressing mechanical problems, found solutions for them and continued to eliminate succeeding difficulties as they arose.

More than 100 modifications were made to the CL-44s by Canadair during the first year's operation.

In addition, under certain conditions, the gross weight can be increased from 205,000 lb. to 210,000 lb., which enabled the aircraft to carry larger loads non-stop across the Atlantic.

The airline and Canadair have developed a pallet loading system which is entirely mechanized. Use of the system has resulted in a major decrease in damage to the aircraft floor and sidewalls, and has reduced transit stops at such points as London, Paris and Zurich from 2 hr. to 1 hr. As an example, one CL-44 has landed, loaded 30,000 lb. of cargo and taken off within 34 min., Jackson pointed out.

The swingtail design of the CL-44 has caused very few problems and has given Seaboard an added advantage when converting the aircraft from all-cargo to passenger use. Because of easy access through the swingtail, complete turnarounds on Military Air Transport Service passenger contracts are being accomplished in only 3 hr., as against a previous 10 hr. minimum. The turnaround includes the offloading of cargo and installation of a passenger configuration interior.

Soviets Predict Rise In Aircraft Exports

Moscow—Russia's Ministry of Foreign Trade has predicted a "significant increase" in aircraft, spare parts and equipment exports in 1962 as compared with the 1961 total, which was never announced.

The Ministry said that its "Aviaeksport" monopoly is now preparing to make large sales of new type aircraft and helicopters other than Tu-104s, Il-18s, An-2s and Mi-4s.

An article in the Ministry's official organ "Foreign Trade" repeats the Soviet claim that four turboprop Il-18s have a lower ton-mile operating cost—18 cents—than the U.S. Electra and British Vanguard and Viscount. The magazine made no effort to refute foreign press criticism of poor operating economy for both the Ilyushin Il-18 and Antonov An-12.

The Russian weekly "Novoye Vremya" previously denounced Western criticism of the Il-18 as "sour grapes" and "slander."

British to Flight Test Noise Requirements

By Herbert J. Coleman

London—British Air Registration Board will flight test takeoff and landing procedures dictated by noise abatement rules at London (Heathrow) Airport as a direct result of airline pilots safety complaints (see box).

As the latest move in the long-standing controversy (AW Sept. 3, p. 32), the board said it will charter a Boeing 707 from British Overseas Airways Corp. for the investigation.

Tests will be conducted by the board's chief pilot, A. D. Davies, and are expected to last several weeks. Considerable emphasis will be placed on various climbout regulations dictated by noise abatement rules.

Board decision followed a symposium on noise abatement sponsored by British Air Line Pilots Assn. at London Airport. This was an outgrowth of complaints by the Guild of Air Pilots and Navigators that procedures at London Airport were only marginally safe.

One point pushed by pilots is that noise abatement should be attacked at the source, with suppression coming from advances in design and engineering. In this area, British government is spending about $1 million a year at the National Gas Turbine Establishment in various studies. These include investigation of blade and compressor noise, and noise factors of air intake.

In addition, BALPA has decided to sponsor a prize fund for designs leading to a suitable silent engine without reducing the power output. Initial BALPA contribution is $1,400 and industry will be solicited for further aid.

Bluntest comment on noise at London Airport was made by C. V. Hole, under secretary of aerodromes planning:

"The noise problem will not be any less serious in the foreseeable future. It is most unlikely that any striking improvement will be made, so all our efforts are bent at reducing noise at the source while holding existing noise at the present levels."

Hole said night jet flights from Heathrow will continue because banning jets at night would be unacceptable and uneconomic. Ministry, however, cut back jet flights during summer months to 3,000 landings and takeoffs (AW Apr. 16, p. 50).

Referring to present noise rules, Hole said the ministry has attained 95% compliance by airlines using London Airport. Training flying has been restricted to weekends and much has been moved to other airports.

Hole warned that noise abatement rules may considerably affect design of the proposed supersonic transport, but contended that the problem will still be to restrict noise within the airport boundaries; supersonic booms were another problem altogether.

Speaking for BOAC, John Nivison, operational engineering and research manager, said noise suppression, considering ground installations, in-flight silencers and increased fuel consumption, costs the state-owned airline about $1.4 million a year. He continued:

"At London Airport, the daytime noise levels are such that we can just perform our long range operations successfully, and then only by using all the anti-noise techniques to which I have referred. Any reductions in the noise levels would mean that we would have to cut out nonstop North Atlantic services unless the wind happened to be in a favorable direction, or someone produced some more efficient and economic engine silencers."

He said that of all the airports from which BOAC operates, the lowest noise levels demanded by authorities are those at London Airport. De Havilland Comets and Boeing 707s are fitted with engine sound suppressors and Nivison pointed out that on the 707s, the weight of the silencers and increased fuel load for a Los Angeles-London flight amount to about 4,000 lb., or roughly 10% of the maximum payload capacity.

Nivison said typical attitude for a BOAC 707 reaching the edge of a London Airport community, after takeoff, is about 1,500 ft. At this point, he added, engines are partially throttled back to reduce noise level, and it has been the practice of some airlines until recently to throttle back until the aircraft ceased to climb, because the noise monitoring post was situated below the flight path.

Aircraft floated by, Nivison explained, making the least possible noise at the monitoring post but at the expense of the community further on, for sooner or later the engines had to be opened up so that the aircraft could climb away.

Sudden increase in the noise was not recorded at the monitoring post but it was soon made evident from the vigorous community reaction.

Present general practice when flying over populated areas after takeoff is to limit the extent of thrust reduction in order to retain a satisfactory climb performance. This ensures that noise reaching the ground steadily diminishes and the airplane reaches sufficient altitude to resume normal climb power without creating a ground noise nuisance.

Former BOAC Chairman Sir Miles Thomas questioned whether steep climb angles at takeoff are in the best interests of all concerned.

"I know the degree of climb is not mandatorily imposed on the pilot, but I equally know that there is strong ethical pressure on jet pilots these days to keep their companies out of trouble that might emanate from noise-measuring devices at the end of runways, and even in inhabited areas some distance from the actual runway."

British Pilot Noise Position Muted

London—British Air Line Pilots Assn. formal position on safety aspects of noise abatement procedure at London Heathrow Airport was considerably muted at a pilot sponsored symposium here recently when the Ministry of Aviation objected to possible controversy which would follow.

Ministry unofficially told the pilots that if the statement was made public in the form planned, the ministry would not participate in the session. BALPA's position was therefore put forth in very general terms.

Pilots position, as originally stated, was that BALPA would not accept any noise abatement procedures which require:

- Air traffic control clearance designed to change headings at low altitude for purposes of noise abatement.
- Turns below 1,000 ft. for noise abatement reasons.
- Reduction of power earlier, or to a greater extent, than is done on a normal takeoff.
- Simultaneous changes of heading and airspeed.
- Climbs at airspeeds less than the maneuvering speeds for existing flap configurations.
- Procedures when weather conditions are worse than 1,000 ft. ceiling and 3 mi. visibility.
- Use of preferential runways for noise abatement when runways are other than clean or dry, crosswind component exceeds 10 kt. and tailwind is greater than 5 kt. for either takeoff or landing.
- Approaches at glide slope angles are steeper than normal for noise abatement, optimum angle for current generation of jets is 3 deg.

Basic BALPA position is that noise should be reduced by engineering and design advances and not by 'marginally safe techniques.'

AIRLINE OBSERVER

▶ Federal Aviation Agency has established a Coastal Air Defense Identification Zone (ADIZ) within 150 naut mi of San Juan, Puerto Rico. The new zone is bounded by a circle having a radius of 150 naut mi centered on the San Juan radio beacon. The Dominican Republic and its territorial waters are excluded, as are the islands of Puerto Rico, Vieques, St. Croix, St. Thomas, Tortola, Virgin Gorda and Anegada. This is the eighth ADIZ operating outside the continental U.S.

▶ Lockheed-Georgia Co. is considering a military proposal that a version of the C-141 jet freighter be designed with a cargo bay 13 ft. high. Present height is 9 ft. 1 in., but military groups feel extra space might be needed for such items as missiles on transporters. The proposal would not affect bay height of the L-300, commercial version of the C-141, which remains at 9 ft. 1 in. (AW Oct. 29, p. 45).

▶ Watch for British parliamentary discussion on a Scottish proposal to make Prestwick a duty free airport similar to the operation at Shannon Airport. Proposal includes an ambitious plan to use airport perimeters for industrial development.

▶ Russian efforts to remove some of the more ridiculous manifestations of secrecy and censorship surrounding airline operations of the Soviet Union and its satellites have not proved entirely successful. Foreigners requesting Aeroflot timetables in Moscow, Leningrad and other main Russian airline hubs are still told that copies are unavailable. Yet Aeroflot offices in Vienna and other Western European cities readily provide such timetables. A new Russian book on the world's commercial airlines—published under Soviet government auspices—was forced to rely on Western sources, especially U.S. and British, for traffic data on state-controlled airlines in USSR's own European satellites.

▶ Bonanza Airlines is the latest U.S. carrier to order the BAC-111 twin-jet transport, confirming an AVIATION WEEK report (Sept. 24, p. 52). The order, worth about $28 million, brings total of firm orders for the aircraft to 36, including 13 on option.

▶ British European Airways has started de Havilland Comet 4B service between London and Paris as a competitive move against Air France's Sud Caravelles on the high density route. BOAC spokesman said use of two Comets was a sales move based on the glamor of the jets. BEA is now operating seven daily flights, using the two 87-passenger Comets and a mixture of Vickers Vanguards and Viscount turboprop transports. No surcharge is made for the Comet flight.

▶ Civil Aeronautics Board plans to reshuffle U.S. flag routes into Latin America (AW Nov. 5, p. 45) may be delayed indefinitely by the possible merger of five Latin American-owned airlines into a supra-national airline. Argentina, Brazil, Colombia, Mexico and Venezuela disclosed the plan at a recent meeting of the Latin American Free Trade Assn. Final disposition of both the U.S. Latin America Route Case and the merger proposal will revolve around the problems of meeting U.S. anti-trust laws and interpreting Fifth Freedom traffic rights.

▶ Congress may take a close look at the Doppler navigation aid feud between the Transport Workers Union and Trans World Airlines. House Government Operations subcommittee, under Rep. Jack Brooks (D.-Tex.), has been gathering data which it may use as grist for a hearing in the near future.

▶ Transport Workers Union has organized the meteorologists and weather observers of Trans World Airlines. Because of their widespread geographical assignment with the airline, the 33 new members will probably be chartered as a new TWU local.

SHORTLINES

▶ **Austrian Airlines** and Scandinavian Airlines System have started a pool operation between Vienna and the Near East using an SAS Sud Caravelle turbojet transport. Three weekly flights will be operated between Vienna and Athens and twice-weekly flights between Istanbul and Beirut.

▶ **Civil Aeronautics Board** has asked the presidents of 11 domestic trunklines whether they would favor increasing the free 40 lb. baggage allowance on domestic flights. CAB said that a 1959 investigation of baggage allowances found the limit fair but suggested that increased capacity of jets might make an increase "operationally and economically feasible."

▶ **Central Airlines** has introduced a "ticket by mail" policy to help passengers avoid waiting in line at airport ticket counters.

▶ **Delta Air Lines** has reported a net income of $5.5 million for the quarter which ended Sept. 30. Earnings for the same period last year were $353,711.

▶ **Eastern Air Lines** will expand its telephone flight information service to 50 cities on its system by Dec. 1. The service provides recorded information covering all of Eastern's flights to callers who dial a widely-advertised telephone number.

▶ **Federal Aviation Agency** Administrator N. E. Halaby told a National Safety Council meeting in Chicago that hydraulic difficulties in jet transports have been reduced by 70% in the past year. He said that in October, 1961, hydraulic malfunctions totaled 12 for every 1,000 hr. of flight. In June of last year, the rate was four per 1,000 flight hours.

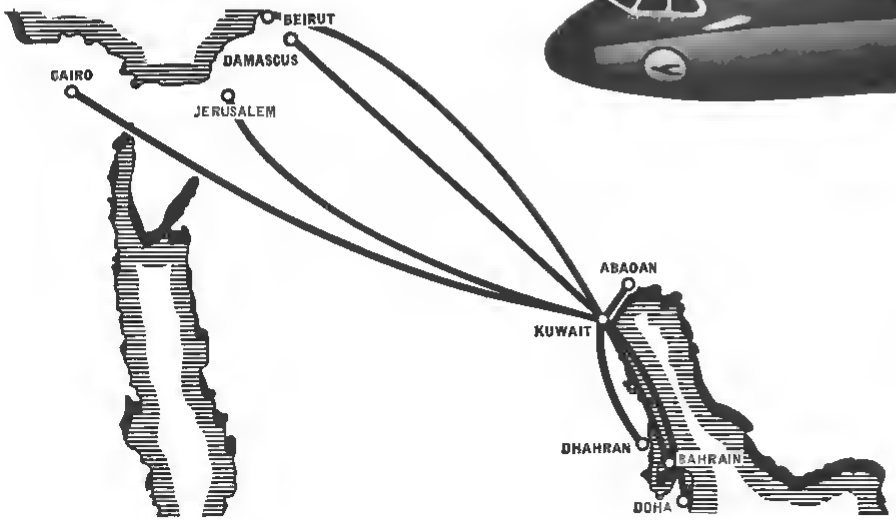
▶ **Irish International Airlines** has reported a 36% increase in the number of its transatlantic passengers carried in September compared with the same month last year. From April through September, the Irish carrier's load factor was 67% on transatlantic operations compared with an industry average of 53%.

▶ **Northeast Airlines** has declared that regional rather than local airports are essential to the future development of New England air services. Northeast said that the regional system would provide airports sufficiently large to handle modern aircraft such as Douglas DC-6B and Vickers Viscount transports.

KUWAIT
CHOOSES BAC ONE-ELEVEN

Kuwait Airways now wholly owned by the Kuwait State Government has decided to employ jet aircraft replacing the Viscount on all present and proposed routes.
After a careful study of the traffic potential on our routes we find that the BAC One-Eleven is the most suitable short-haul jet. For the longer routes larger jets will be employed
We believe that the BAC One-Eleven will provide comfortable and speedy travel to our customers as well as economical operational results to the Company

Nusf Et Yusif
Chairman, Kuwait Airways



BAC

JET SUCCESSOR TO THE VISCOUNT WITH EVEN BETTER THAN VISCOUNT ECONOMICS

ONE-ELEVEN

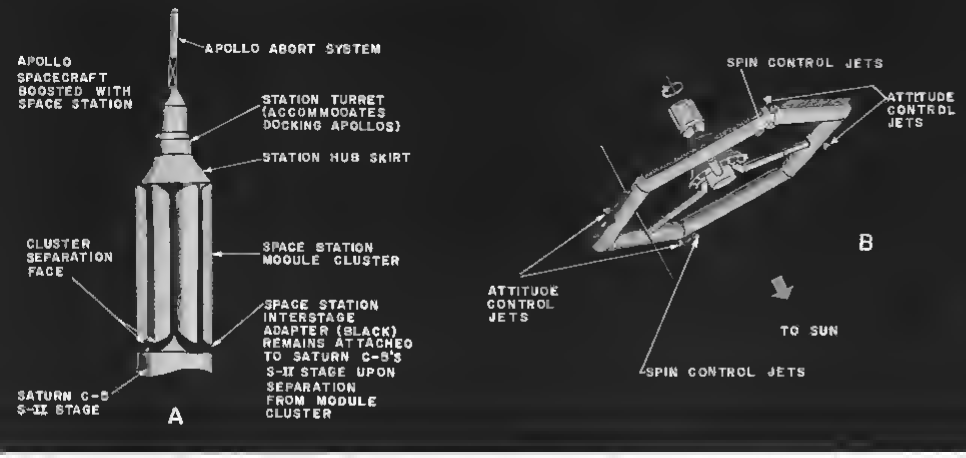
TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

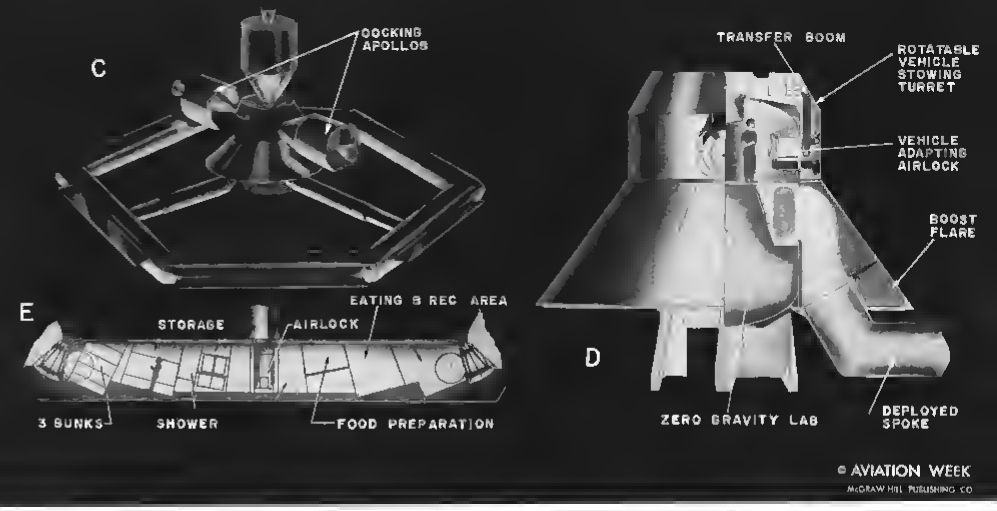
THE SHORT HAUL JET

BRITISH AIRCRAFT CORPORATION

ONE HUNDRED PALL MALL LONDON SW1 ENGLAND

USA: BRITISH AIRCRAFT CORPORATION (USA) INC., 888 JEFFERSON DAVIS HIGHWAY, ARLINGTON 2, VIRGINIA





LAUNCH AND DEPLOYMENT CONFIGURATIONS of proposed manned, self-deploying space station are illustrated in drawings above. Launch configuration (A) shows interstage adapter atop S-2 stage of Saturn C-5 launch vehicle. After station separates from the booster, Apollo separates from station hub and rotates end-to-end, so that nose cone can mate with top dock of the hub in deployed configuration (B). Bottom of hub's flared skirt points toward sun. Spin control jets produce 50 lb. thrust each. Spin control maintains station rotation at about 3 rpm for artificial gravity of 2g. Attitude jets maintain spin axis in orientation to within 10 deg. of sun for maximum solar cell energy. Station, single Apollo and three men would have 154,500 lb. equivalent earth weight in orbit.

ARTIST'S CONCEPTION OF SPACE STATION shows three Apollo vehicles at hub (C). Top Apollo is docked in ideal position on station spin axis; other two are stowed symmetrically on hub opposite each other to avoid spin axis shift. Layout in station hub (D) includes zero-g lab mounted on rotating platform turning in opposite direction to station and producing speed of relative zero. Flared lab skirt serves as aerodynamic fairing during boost phase and additional protection against meteoroids. Cross-section of living module (E) shows secondary floor used to hold down gravity variant to .2g from module center to end. Living module would have three bunks on each side of aisle to sleep six crewmen. Seventh crewman would be standby for monitoring module's control center.

Self-Deploying Space Station Will Support Experiments, Flight Procedures Checkout

First step toward development of a manned earth-orbiting platform will begin early next year with a request for proposals on a six-month detailed design study of a self-deploying space station.

National Aeronautics and Space Administration is expected to issue its proposal request in January for the station—which is planned to be operational by 1966 (AW Sept. 10, p. 33) under joint sponsorship of NASA, as project manager, Defense Dept., Federal Communications Commission and U.S. Weather Bureau.

Requests from scientific groups and universities in the U.S. and abroad to conduct experiments and human factors investigations in the space station are expected to be so numerous that industry members feel the project may grow into an international effort.

Participation by U.S. Air Force in the project could establish a basic, but extensive framework from which to move into military space operations.

There currently is no authorized requirement for military applications at this time.

Air Force's projected manned orbital development systems (MODS) program is viewed as questionable by military and industry alike.

Indications are that a "Blue Gemini" (AW Oct. 8, p. 39) might be the initial spacecraft allotted to the Air Force for experiments, perhaps in 1964 (AW Nov. 5, p. 42). This vehicle, however, would not afford even a close approximation of the experience which could be gained with a manned orbiting space station of the size and content of the one proposed under the NASA program.

The station will provide an opportunity to check out critical space radar, optics, and communications components under actual operational conditions affording the opportunity for long exposure to a hostile environment. Experience would also be accumulated in rendezvousing, docking and numerous other specific space tasks involving human monitoring.

For civil and military applications, the manned orbiting space station could function as an orbiting launch platform for lunar and interplanetary missions and as a key element in a satellite communications.

According to present plans, NASA will award three design study contracts, with one of the three contractors ultimately selected to develop the space station.

One-third scale model may be built as a proving vehicle for initial launch, probably followed by construction of three full-scale space stations for successive launches in packaged configurations from Cape Canaveral by a Saturn C-5 booster.

Estimates are that the station launch weight would be about 170,300 lb.—including 75,150 lb. for structure; 63,450 lb. for station equipment; 21,700 lb. for an Apollo vehicle, its crew and abort escape system and 10,000 lb. for interstage structure. In orbit with a crew of 21 and with seven Apollos docked at the hub, the total station weight would be 249,900 lb.

North American Aviation's Space and Information Systems Division has completed for NASA a broad two-part study of the basic requirements for the manned orbiting space station, (AW Mar. 19, p. 27, Apr. 16, p. 75)—including construction of a one-tenth scale model of the station. This was a hexagonal configuration with rim modules connected to a hub by three telescoping spokes. It was delivered to NASA last month.

The model represents a station which is released from its packaged configuration at the press of a button to demonstrate the kinematics of deployment.

North American's study, an extension of a basic concept of a space station originally advanced by NASA's Langley Research Laboratory, should be at least a first-order approximation in the process of establishing final parameters for the design and development of the manned orbital space station in the upcoming industry competition.

Company Studies

Anticipating this competition, other companies—including Boeing, Lockheed's California Division, Martin Denver and General Dynamics Astronautics—are conducting intensive in-house studies on the complete space station to be ready with data in all design and operational areas.

NASA also is funding industry studies related to manned orbital space station development in areas which it feels require preliminary investigation—waste management, water reclamation, seals and connections, qualification testing and operations analysis.

These studies should be completed by the end of the year for analysis by NASA before general specifications are compiled and issued for the space station competition within industry.

As envisioned by NASA and North American, the space station is projected to be launched by a Saturn C-5 booster, consisting of S-1D and S-2 stages in a 300-naut.-mi. circular earth orbit with an inclination of about 30 deg. The orbital altitude was selected as a compromise between levels involving high radiation and those involving significant atmospheric drag. Operational life of the station is expected to be approximately three years.

Capability of the Saturn C-5 booster would permit a single Apollo spacecraft to be launched with the space station.

Apollo crew could monitor, from the Apollo, the deployment of the space station, then could enter the station to serve as the initial crew and conduct all operations necessary to prepare the orbiting platform to receive additional crew members from personnel transport supply spacecraft.

In an emergency, the Apollo spacecraft could accommodate an escaping crew and return it to earth since the space station would have no re-entry capability.

For launch by the Saturn C-5, the space station package configuration containing the hub, three spokes, and six rim modules would be stacked to measure about 33 ft. in diameter and approximately 103 ft. high. The cluster of six modules would form the outside of the package surrounding the three telescoped spokes.

The station's hub is attached to the top of the vertical stack of modules, and the Apollo spacecraft is positioned atop the hub. Control of the launch trajectory could be accomplished with the Apollo guidance system.

Separation Procedure

When orbital altitude is attained and booster separation initiated, separation fittings on the top and bottom of the modules free the Apollo from the hub and the bottom of the packaged modules from an adapter which remains attached to the Saturn S-2 stage. Battery-powered mechanical actuators initiate deployment from the launch configuration symmetrically to avoid interference between space station members. Busemann-type hinges—devised by Dr. Adolph Busemann of Langley Research Center—at the end of each module allow each member to rotate freely about its own hinge centerline.

Spokes, telescoped to half their length, also are hinged to extend by following the motion of the modules. At the end of deployment, module and

spoke ends are latched in place for an efficient seal to prevent air leakage

When deployment is complete, a 63½ ft-long panel of solar cells with an area of 320 sq ft unfolds from each module Solar cells for the hub are mounted on its bottom in a 405-sq ft. panel pattern of three groups between each spoke-hub interface

Each panel of cells affords enough energy to operate the space station element to which it is attached and gives an independent power supply to each element The station's solar cell arrays will accommodate a peak power requirement of approximately 19 5 kw for the station, but average load probably would not exceed 12 kw

Peak Power Load

Each rim module's peak load requirement would be about 3 kw Peak power for approximately 20,000 lb of experiments is not expected to exceed 1 5 kw Spin axis of the space station is oriented so that it is aligned with the sun to permit the fixed solar panel arrays, positioned in a plane at right angles to the axis to face the sun Space station's maximum period of darkness will be about 36 min

In its deployed configuration, the space station will measure approximately 150 ft across the corners of the modules as arranged in the form of a hexagon Each module will be 75 ft long and have a 10-ft outside diameter. Spokes will have a 5 ft dia , with the smaller telescoping section about 4½ ft across

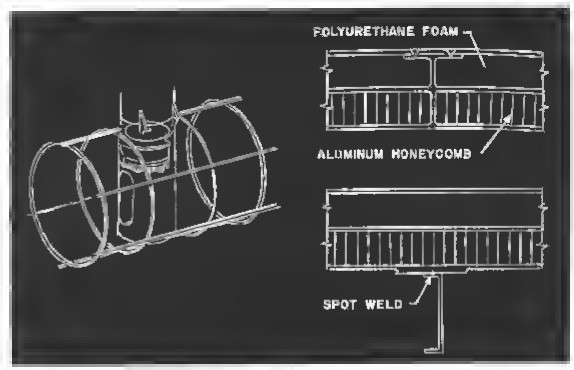
Hub will be about 30 ft high Diameter at the top of its tapered upper portion will be just under 13 ft , identical with that of the Apollo vehicle section which mates with the hub for support during the Saturn boost phase Below the top of the hub is a cylindrical section 17 ft in diameter and slightly over 6 ft wide, designed to accommodate stowage of a complement of six Apollo spacecraft

The top of the hub also affords a station to accommodate another Apollo vehicle which would be in alignment with the spin axis of the space station Flared skirt of the hub, extending out from the bottom of the cylindrical section, is about 13½ ft high and has a 33-ft dia at its bottom

The skirt, which surrounds a zero-gravity laboratory in the lower portion of the hub, serves as an aerodynamic fairing during the boost phase of the Saturn C-5 As part of the hub in space, the skirt affords an additional amount of material to protect against impact of meteoroids The skirt's bottom surface provides sufficient area for the hub's solar panel array.

Paired, oppositely pointing spin control jets, using hypergolic bipropellant and developing about 50 lb thrust per jet, are mounted atop two diametrically opposed joints of the hexagonal rim configuration to initiate and maintain the station's rotational velocity of approximately 3 rpm and produce an artificial gravity of about 0.2g.

Eight 50-lb thrust attitude control jets—four each positioned diametrically opposed for a cross pattern on the top and bottom of the hexagonal rim—maintain the attitude of the space station so that solar panels are oriented to within 10 deg. of the sun ensuring maximum energy output



STRUCTURAL ASPECTS of module could incorporate an aluminum alloy framework of rings spaced at 50-in. intervals and six longerons equally spaced around module perimeter. Spoke and airlock arrangement is shown in skeleton framework. Module wall would consist of three layers of aluminum alloy, each one inch apart, with polyurethane foam filling the outer compartment and aluminum alloy honeycomb in the inner layer

Attitude Control

The jets also alter the attitude of the station by one degree per day to account for normal precession, and reorient the station to compensate for an externally applied disturbance such as that produced by an Apollo in the docking or stowing procedure at the hub

Disturbances within the space station wouldn't cause permanent disorientation of the station's spin axis But they could cause a wobble, which could be damped with a precession wheel In an emergency, the attitude control jets could be used to damp station wobble

Procedure for the initial Apollo docking operation, after separation of the space station payload from the Saturn booster and detachment of the Apollo from the top of the hub, would be for the Apollo to turn itself end-for-end (180 deg.) Thus, the nose cone portion of the spacecraft would be aligned with the space station's spin axis, directly over the hub, where it engages the hub's top airlock This is considered the ideal docking position on the station to avoid spin axis disorientation and mass unbalance

Before Apollo crewmen can enter the space station, the pressure would have to be equalized between the Apollo command module and the station, whose modules spokes and hub are sealed before launch with enough air for initial pressurization of the station This pressure equalization between the Apollo and the station could be done with bleed valves in the airlock doors

To accommodate multiple stowage of Apollo spacecraft, each tow vehicle must be situated in diametrically-opposed positions on the hub cylinder to avoid spin axis shift In movement of vehicles from docking position on the hub top to stowage position on the hub side, mass unbalance must be avoided to prevent wobble of the space station

The hub's upper section—or turret portion—is driven in a direction opposite to the space station's rotation, in effect becoming a non-rotating member in inertial space

Drive Mechanism

Drive mechanism raises a stowing boom with integral attachment ring up from the hub over the station's spin axis The docking Apollo connects to the attachment ring, and connection is made to the airlock in the top of the hub if Apollo crew members want to enter the space station at this position, which is considered preferable They may, however, defer exit until the boom swings the Apollo sidewise and down to one of the stowage positions located circumferentially on the hub

The power rotating the hub is cut, and the turret approaches the space station's rotational velocity as a result

of hub bearing friction It then stops at one of several preset positions, where a cylindrical shell moves out from the hub to mate with the stowed Apollo's airlock

Hub Departure

Departure from the station hub would involve counterrotation of the hub turret, and the departing Apollo would be swung up to the hub's top docking point The remaining Apollo spacecraft stowed on the hub would be rearranged symmetrically and the turret allowed to approach the rotational velocity of the station

In an emergency situation, it might be possible for a departing vehicle to leave the hub without initiating hub counterrotation. Some of the Apollo spacecraft would always be stowed at the hub ports to facilitate rapid escape of station crew members Movement of crewmen from the nin modules to the hub through the spokes might be facilitated by an endless belt to counteract the forces imposed by the rotation of the space station

After crew members enter or leave the hub, a period of environmental adaptation probably would be necessary, particularly in emergency situations—for example, when the station has to be evacuated rapidly This condition could extend the time normally required for return to earth in the Apollo because crew members might be dizzy for several hours after they left the space station, thus making a fast return to earth unfeasible

While a crew of 21 would be feasible for a 150 ft dia space station, the crew for an initial period of about six to eight weeks would be composed of not more than 12 spacemen who had undergone intensive training in all facets of rendezvous, docking, station operation and survival Buildup to a strength of 21 crewmen might cover a year

Larger Crew

Crew complement of more than 21 could be accommodated, but would require more than seven docking points on the hub or redesign of the Apollo spacecraft interior to accommodate transport of a larger crew in each vehicle

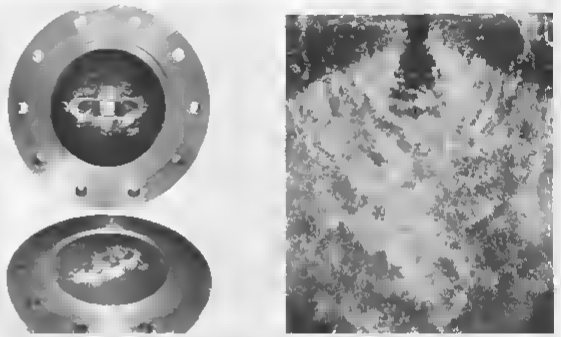
Station crew of 21 probably would require more than 1,800 lb of drinking water yearly, plus other quantities for hygiene functions Most of this water probably would be recovered through reclamation processes About 1,000 lb of makeup water, and 14,000 to 15,000 lb of processed food per year might be ferried to the station by Apollo resupply vehicles

Saturn C 1 or a Titan 3 space booster could be used to orbit a three-man Apollo, or a modified version to accommodate five men or three men and cargo Any requirement to evacuate the full complement of space station crewmen would require a new spacecraft and larger boosters than the C-1 or Titan 3 to put it into orbit for rendezvous with the station

In addition to the alternative of increasing Apollo capacity to five and using it for personnel or personnel and cargo, an additional module for resupply could be added to the existing configuration Or the earth-orbit configuration of Apollo could be used effectively if all but essential equipment were removed from the spacecraft to increase its volume for cargo

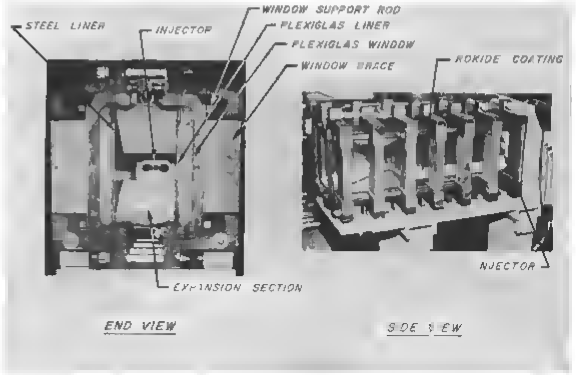
Three alternate modules of the space station would be allocated for living quarters with facilities for food preparation, sleeping, and recreation The remaining modules would be used for the primary mission—laboratory experiments and station operation and control One of the work modules would have a command center which would be able to oversee all activities in each module and exercise general control over operations

Straight modules rather than curved configurations seem indicated because the straight form is better adapted to a feasible launch package and is simpler to build However, use of straight, cylindrical modules in the hexagonal perimeter of the space station requires inclusion of a secondary



Triplet Injector Studied for Liquid-Fuel Engines

Aerojet-General Corp is studying triplet injector concept as a possible injector system for large liquid-propellant rockets Photograph above shows injector plate and resultant turbulent eddy produced by injector Below is transparent thrust chamber where the injector is under test Aerojet feels use of relatively few large-element streams to impinge on each other to cause vaporization could eliminate need for up to 15,000 fuel and oxidizer orifices and complex manifolding system if conventional injectors are used



floor to avoid excessive deviation of gravity line from a position perpendicular to the floor of the rotating station.

With the straight modules personnel would experience a change in gravity as they walked through the module. At the end of the module, they would experience the sensation of standing on a slanting floor—a sensation which would not be experienced while walking through a curved module.

Floor Design

The difficulty could be overcome by designing the floor as a series of arcs of increasing radii from the space station's center, then reducing the arcs to straight floor lengths approximately perpendicular to the line to the station center, and connecting the floor segments by short stairs. This change would produce a gravity variation from the module's longitudinal center to its end of approximately 0.20g, which should be satisfactory for crew members.

Accommodations in each of the three self-sufficient living modules would be the same for a crew complement of seven men. Sleeping and hygienic facilities would be at one end of the module, with food preparation and recreational facilities at the other end. Mechanical or electronic equipment would be located in the center of the module, away from the crew's sleeping quarters.

Six of the crew would have three bunks on each side of the central aisle, while the seventh crewman, a monitor, would be berthed outside the general sleeping compartment and opposite the module control center.

Control Center

This control center would contain power equipment, environmental instrumentation and the station intercommunication and alarm system. The seventh crewman would alert the station in an emergency. A two-day supply of surplus food would be stored in each living module for emergencies.

Three work modules will be located at the ends of the spokes radiating from the hub so that on-duty crewmen can have access to all work modules and the hub without the need to enter a living module to disturb off-duty crewmen.

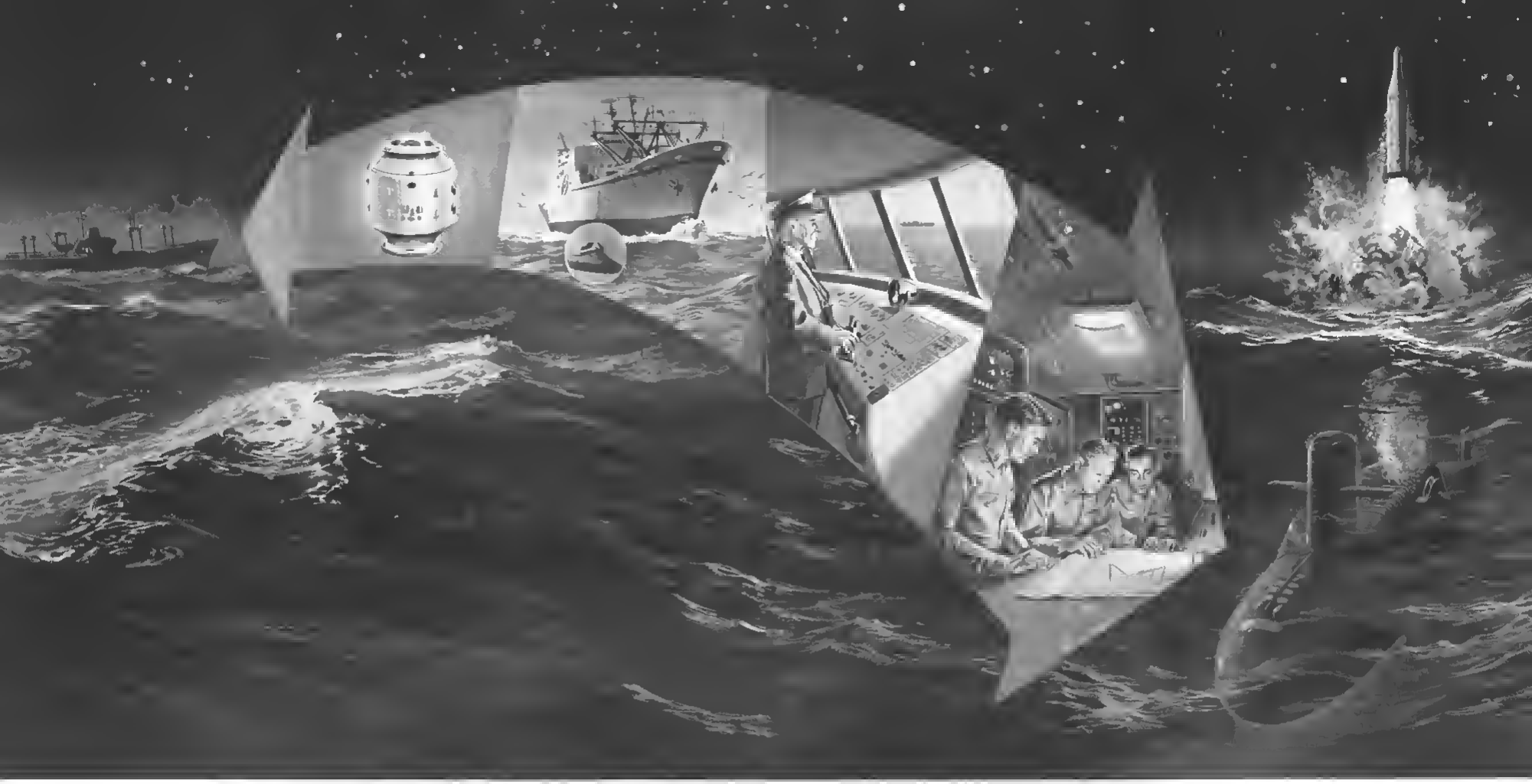
Work modules would contain laboratory and test equipment for specific subsystems such as propulsion, power and environmental control. It would be advantageous to group specific subsystem equipment in a single work module, but weight distribution may require it to be distributed in two or more modules.

One of the work modules would house the station command center, including communications and a control function which would be independent of any ground station. As a safety factor, each module would have some provision for specific control functions and the ability to control the station completely for a limited time.

Equipment would be installed on each side of a center aisle less than 3 ft. wide. Equipment racks probably would not be more than 2 ft. deep and 6 ft. high. Where crewmen would be seated for extended monitoring, consoles and displays would be recessed in the wall to avoid aisle obstruction.

Access to the module internal wall to repair damage resulting from meteoroid impact could be simplified with equipment modularized and hinged on the aisle at the floor line. This would permit pulling the upper portion of the equipment package into the aisle to get behind it to the wall. Use of sliding equipment modules to permit pulling out for access to the inner wall is another possibility. Seated crewmen probably would face in the direction of station rotation to minimize psychological and physiological effects associated with turning.

Another working area is contained in the hub. The central hub section is



Over and under

Since the first Gyro-compass was demonstrated in 1911, Sperry has had undisputed world leadership in precision navigation—setting ever more advanced standards for the world's commercial and military fleets.

Today in hydrospace, significant Sperry achievements in sea systems are meeting more critical demands in navigation and control than ever before.

An example of the continued development and refinement of basic systems is the Mark 19 Gyro-compass—world-famous heading reference which has consistently kept in the vanguard of the navigational art.

Taming the unstable medium of the seas for many surface ships is the Gyrofin® Ship Stabilizer which compensates automatically for roll encountered in heavy weather. Gyrofin has a counterpart—the Gyro Stabilizer—aboard the latest nuclear subs.

SURIC—Surface Ship Integrated Control—will soon provide "hands off" control of destroyers and other vessels, displaying all functions in consoles on the bridge.

On Polaris-firing submarines, Sperry is navigation systems manager. Sperry SINS (Ship's Inertial Navigation System) equipment provides a continuous record of distance traveled, direction, ship's position, pitch and roll and every other critical motion—then supplies all navigational data for the exacting job of aiming the Polaris itself. Other Sperry sea systems range from periscope optics to passive underwater detection for ASW . . . from diving, steering and depth-keeping controls to the Celestial Altitude Recorder that focuses on the stars.

And Sperry is a leading producer of radars, Lorans, Gyropilots® and a host of other gear—plus expert field service—that lets ships of every kind sail over and under the sea with confidence. General Offices: Great Neck, N.Y.

SPERRY

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attached rigidly to the spokes and rotates in the same mode as the station rim. Hub lower compartment affords about 45 sq ft for conducting zero g experiments and is mounted on a motor-driven platform rotating in a direction opposite to that of the space station at a rate resulting in a relative rotational speed of zero.

Screened Platform

Rotating platform is screened to avoid adverse psychological effects on crewmen which could be induced by looking at the hub's rotating walls. Connection between the zero g laboratory and the upper compartment of the hub used for crew transfer to the spokes or the docked Apollo vehicles is through a floor hatch in the upper compartment.

Pressure bulkheads and airlocks would be installed at the end of each spoke and between rim modules to divide the space station into 10 compartments—six modules, three spokes and the hub. Each of these compartments would be fitted with an environmental control system sufficient to support the compartment's normal activity continuously or function for a larger crew during shorter periods.

Each compartment, except the spokes, would have a standby system for safety purposes.

Environmental control system will afford heating and air supply functions, with radiators and module surface coatings maintaining a balance between station heating requirements and solar, equipment, and body heat inputs.

Air and humidity controls will condition the compartments, remove dust, contaminants and odors, prevent carbon dioxide accumulation, and maintain adequate pressure levels for both oxygen and nitrogen for a 10 psi environment. High-pressure vessels for oxygen and nitrogen will be capable of pressurizing the space station twice after it is deployed in space with its original atmosphere.

Space suits will be included in the station's equipment for emergency conditions or when crewmen would have to enter a depressurized compartment to make repairs. However, crewmen normally will function without suits in the "shirtsleeve" environment since it would not be feasible to wear pressurized, or even deflated, suits continuously.

Wall Structure

Station wall structure, designed to minimize meteoroid penetrations, would incorporate three layers of aluminum one inch apart. The space between center and inner layers would be filled with aluminum honeycomb, and the space between the outer layer and center layer would be packed with polyurethane foam.

Impact by both small, dense meteoroids and larger, less-dense meteoroids is probable and will result in station surface deterioration by pitting or in penetration of the station wall.

Effects of punctures by meteoroids, or those resulting from internal explosion of spacecraft equipment, would be minimized by the airlocks and use of the separate and duplicated environmental control systems in the hub and each module. Also, the large volume of atmosphere and the pressure levels in compartments would allow considerable time before loss of air would pose a danger.

Extensive Damage

It is probable, however, that if two or more compartments were damaged extensively and simultaneously or in rapid succession, the mission would be aborted and the space station abandoned. Greatest danger would be involved if the compartments damaged were work modules connected by the spokes to the hub where Apollos would be docked to receive crewmen.

In the event of fire or severe contamination of a compartment by toxics, the compartment air could be dumped to minimize danger.

Space suits for crewmen would provide an additional safety factor for a limited period.

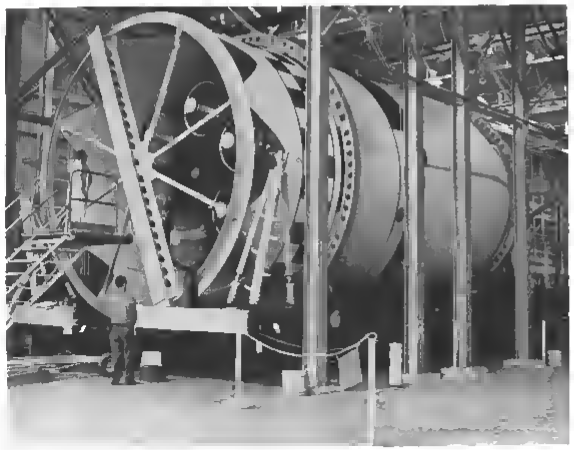
Space radiation would be another hazard (see p. 73) and would determine the number of crews that would be rotated to man the space station on a continuous basis. Medication possibly could be devised to minimize biological effects of space radiation, but precautions would have to be taken to ensure that toxic effects of the medication were not excessive. Additional shielding could minimize the effects of radiation and probably would be justified, considering the high logistics costs involved in the requirement for more frequent boost vehicles to compensate for reduced crew duty cycles.

Shielding Weight

Additional shielding weight would pose no payload problem for the Saturn C-5 booster because the C-5 could accommodate about 30,000 lb more than the basic space station weight now contemplated—and more if an Apollo were not boosted with the station.

Communication system on the space station would include on-board communications, monitoring and data processing, television and station-to-Apollo and station-to-ground links. Scientific experimental data collected in the space station would require a large amount of information to be transmitted to earth almost constantly.

On-board communication system would include such functions as crew voice and emergency links. The crew voice link would hook up the individual modules, hub, and any support



S-4 Readied for Shipment to Marshall

Saturn S-4 second stage of the National Aeronautics and Space Administration's Saturn C-1 launch vehicle is placed in a 25 ton transporter at Douglas Aircraft's Missiles and Space Systems Division, Santa Monica, Calif., for shipment to Marshall Space Flight Center, Huntsville, Ala. S-4 stage will be at Marshall for six months of dynamic testing before being returned to Douglas for other tests.

NAA Competition Team

Industry interest in NASA's projected competition for a six-month detailed design study of a manned, self-deploying space station is indicated by the team of eight aerospace companies selected by North American Aviation's Space and Information Systems Division to work jointly with it on a proposal

NAA already has completed a two-part study for NASA covering the feasibility of a concept for a self-deploying space station and has constructed a one-tenth scale model to demonstrate deployment kinematics (see story).

Technical areas of responsibility and the companies selected for them by NAA

- Communications, including on board links, monitoring and data processing, television and station to-spacecraft and station-to-ground links—Sylvania Electronics Systems Division
- Stabilization and control, including spin control, attitude orientation and wobble damping—Minneapolis-Honeywell
- Environmental controls—AiResearch Division of Garrett Corp.
- Nutrition and hygiene—Whirlpool Corp.
- Water reclamation—Ionics, Inc
- Power supply (solar cells)—Hoffman Semiconductor Division
- Batteries—General Electric Co.
- Power conversion and control—Westinghouse Electric Corp

Technical area existing for team contractor selection is waste management

spacecraft in the region of the station, as well as crewmen functioning in space suits inside the station

On-board monitoring system would provide the alert for conditions of danger in any area of the space station and would provide time-records of station critical functions to anticipate failures

On-board data processing system, consisting of recording equipment, a programmer and a computer, would handle all experimental data reduction functions except those handled by real-time transmission Experimental data is expected to stem from five broad categories of investigation—space environment astronomy, reconnaissance, material and component testing and space communications Total experimental payload is expected to weigh approximately 20,000 lb

Television system would monitor space station areas left unattended because of high radiation environments or high-temperature exposures which could result from some experiments System also would be used to monitor docking and departure operations from the station hub

Flight Propulsion NEWS

A report about progress in research and products from the Flight Propulsion Division of the General Electric Company

First United States Jet Flight Took Place 20 Years Ago

CINCINNATI, Ohio—On an early Fall morning 20 years ago, an odd-looking fighter-size aircraft warmed up on the apron ahead of a long, lonely runway at the Muroc bombing and gunnery range in the Mohave Desert of California.

Suddenly, with an unusual roar, the propellerless craft rolled down the runway, picked up speed for some 1000 yards, and became airborne.

The date was October 2, 1942. The strange aircraft was the Bell XP-59 Aracomet, powered by two General Electric I-A turbojet engines, whose roar marked the climax of one of America's greatest technical success stories, and signaled the beginning of the "Jet Era" in the United States.

The first turbojet flight in world history had been made three years earlier in Germany by a Heinkel HE178. In 1940, the Italian Campini was flown publicly, with reciprocating engines powering the compressor. Then in 1941, Great Britain revealed details of the Whittle W-1 turbojet to General "Hap" Arnold, U.S. Chief of Army Air Forces.

At a historic meeting in September of 1941 in Arnold's office he asked the General Electric Co. to study plans of the British turbojet designed by Frank Whittle, and to produce 15 jet engines.

The decision was based on General Electric's experience with gas turbines, compressors and turbosuperchargers—resulting from work pioneered by G.E.'s Dr. Sanford A. Moss as early as 1903. Less than a year after G.E. was assigned the project, the idea of an operational jet engine became a reality. The first U.S. jet engine was assembled at G.E.'s Lynn, Massachusetts plant two weeks ahead of schedule. It was designated the I-A.

Bell Aircraft, designer of the plane, was early too, so that work began immediately to mount two I-A engines in the XP-59. Each I-A weighed 780 pounds, and developed 1250 pounds of thrust.

Then began a cloak and dagger episode unequalled in the annals of American aviation.

Under strictest secrecy, the dismantled XP-59 aircraft set out cross country by railroad flatcar—under armed guard—from Bell's Buffalo plant to the Muroc range. For the duration of the trip a huge compressor fed air through the engines to keep them slowly turning so the bearings would not dent.

The rest is history, and the XP-59 legacy of technology grew rapidly. By 1946, General Electric had successfully demonstrated the advantages of the axial flow compressor for turbojet propulsion. Its first engine using this principle, the J35, was quickly followed by the famous J47, workhorse turbojet of the North American F-86 and Boeing B-47.

SHROUDED IN SECRECY, the United States' first jet aircraft is towed toward hangar at Muroc Dry Lake, California. The G.E.-powered XP-59 is cloaked with a dummy propellor and camouflaged air intakes to hide its two secret I-A turbojet engines.

The J47 today claims more actual combat hours in military aircraft than any other jet engine.

Today, G.E. engines mark the 20th anniversary of the historic XP-59 flight in 1942 by powering both large and small military and commercial jet aircraft to new levels of performance. The famous J79, the 16,000 pound thrust class engine that became the Nation's first Mach 2 turbojet in 1958, provides power for the F-4B, A-5A, B-58, and F-104. And, G.E.'s smaller J85 offers the highest thrust-to-weight ratio of any operational engine in the Free World today. These two engines have powered military aircraft to 45 international speed and altitude records.

And the legacy keeps growing. General Electric is developing electrical power and propulsion systems for space vehicles, advanced lift engines for VTOL aircraft, and high-thrust, light-weight turbojets for supersonic commercial airliners and hypersonic aerospace craft . . . efforts which mark a fantastic measure of technical progress since that strange looking aircraft took off on an October morning in 1942.

U.S. Marines Pick T64-powered CH-53A

STRATFORD, Conn.—Twin General Electric T64 turboprops have been selected to power the U.S. Marine Corps' new heavy assault transport, Sikorsky's CH-53A.

Capable of speeds over 200 mph, the new CH-53A will carry payloads up to nine tons, and will be the largest helicopter of its type in the free world. Delivery is expected to begin by 1965.

U.S. Marines' T64-powered Sikorsky CH-53A will play an important role in vertical envelopment operations during combat.

At normal gross weight of 33,267 pounds, twin T64's will give the CH-53A a cruising speed of 172 mph with a four ton payload on 230 mile military missions (4 tons 115 miles out, 2 tons back). Under overload conditions, the aircraft will carry a nine ton payload on shorter missions.

Flown by a three man crew, the CH-53A will carry 30 combat-equipped troops and will be capable of carrying 63 troops in a high-density seating arrangement. As a flying ambulance, it will carry 24 patients and three attendants. A full-size rear opening will permit easy loading and unloading on the ground.

Designed for helicopter and fixed wing application, the 2850 hp T64 is the first gas turbine to approach the low fuel consumption of reciprocating engines. With a power to weight ratio of 4 to 1 and ability to operate continuously at angles from 100 degrees nose up to 45 degrees nose down, the T64 is an outstanding V/STOL powerplant.

In addition to its new application aboard the CH-53A, the T64 has been chosen to power the Vought tri-service VTOL transport and the deHavilland Caribou II Army STOL transport.

G-E T58's To Power U.S. Navy's New VTOL Ducted-Fan Transport

BUFFALO, N.Y.—The U.S. Navy and Textron's Bell Aerosystems Company have announced a technical proposal for a jet powered, ducted fan VTOL transport to be built by Bell.

The proposed aircraft represents the Navy-managed portion of the tri-service VTOL program, and will be used to explore feasibility and military potential of such a VTOL transport.

Four General Electric T58 turboshaft engines will power the proposed aircraft, which features dual tandem, ducted propeller design. Piloted by a two man crew, the new VTOL transport is expected to carry six passengers or a 1200-pound payload of cargo or instrumentation.

Span of the aircraft will be 39.2 feet. It will be 36.3 feet long and 16.3 feet high. Weight will be in the 15,000-pound range. The aircraft is expected to fly at speeds up to 350 mph.

The four General Electric T58 engines, rated at 1250 horsepower each, are mounted on either side of the fuselage at the aft end of the aircraft. Engine power is transmitted through an interconnected system of shafts to drive the propellers.

Vertical takeoff and transition to forward flight is accomplished by the four ducted-propeller units which rotate to a vertical position for takeoff, then return to the normal position for forward flight.

The ducts increase thrust of the propellers during VTOL, and serve as lifting surfaces (wings) during forward flight.

The Navy's proposed VTOL research aircraft begins a new role for General Electric's T58 aircraft engine. Until now, T58's have been used exclusively in helicopters. All the U.S. military services, several foreign governments, and a large number of airlines throughout the world use the T58 or its civil counterpart, the CT58—first U.S. gas turbine certificated for helicopters.

Four General Electric T58 turboshaft engines will power U.S. Navy's ducted-fan VTOL transport at speeds up to 350 mph.

NEW CARAVELLE HORIZON 10A, built by France's Sud-Aviation and powered by two aft-mounted General Electric CJ-805-23C turbofan engines, has successfully completed its maiden flight at Toulouse, France. Up to 94 passengers can be seated in this improved version of the short/medium range Caravelle, which is now in service with a score of airlines. Combined configuration improvements and the powerful General Electric engines, each rated at 16,000 pounds takeoff thrust, provide the new Caravelle with greatly improved takeoff and time-to-climb performance, shorter landing requirements, and up to a five percent increase in maximum speed capability.

G.E. Starts VZ-11 Phase II Development

CINCINNATI, Ohio—Go ahead for Phase II development of the VZ-11 lift fan V/STOL flight research aircraft has been okayed by the Army through additional funding of $3.6 million to General Electric.

The funding completes the original $10.5 million contract awarded G.E. by the Army's Transportation Research Command (now an element of the Army Materiel Command) to develop and test a lift fan V/STOL research aircraft. Initial flight testing of the fan-in-wing VZ-11 will take place in mid-1963.

General Electric first received $6.9 million in late 1961 to test the flight characteristics of its lift fan system. In-wing and nose-mounted lift fans, powered by exhaust gases diverted from two G.E. J85 turbojets, provide vertical thrust for the VZ-11. For horizontal flight, diverter valves close off the lift fans and direct turbojet exhaust rearward. Lift fan efficiency comes in their 300 percent increase of available engine thrust. In all lift fan systems, basic engines can be sized for cruise conditions but not oversized to meet vertical flight requirements.

Dave Cochran, general manager of G.E.'s Flight Propulsion Laboratory Department, said, "We feel that continuation of Army funding for fan-in-wing aircraft is evidence of the military's confidence in the VZ-11 Flight Research Program. The lift fan eventually will be suited to a whole new family of aircraft with the maneuverability of helicopters and the cruise speed of jets."

Ryan Aeronautical Company, San Diego, California, as major airframe subcontractor, will design, build and flight test two VZ-11 aircraft. Ryan was previously awarded $3.5 million from G.E. under Phase I, and will receive an estimated $1 million under Phase II of the program.

Lift fans have been one of the most thoroughly tested flight propulsion systems for use in V/STOL aircraft. More than 300 hours of static and wind tunnel testing have been made by G.E. and the National Aeronautics and Space Administration at Ames Research Center, Moffett Field, California. These successful test results led to the Army's decision in 1961 to start its VZ-11 Flight Research Program.

FOR MORE INFORMATION

If you would like additional information on the General Electric flight propulsion systems discussed above, write on your company or organization letterhead to: General Electric Company, Sec. 206-54, One River Road, Schenectady 5, New York.

GENERAL ELECTRIC

Astronaut Protection Theories Reported

By Cecil Brownlow

Paris—Methods for protecting crew members from hazards of radiation and predicted debilitating effects of weightlessness during prolonged interplanetary or orbital flights were subjects of major concern to leading Western and Eastern bloc scientists here for the International Symposium on "Basic Environmental Problems of Man in Space."

Soviet and U.S. scientists agreed that cosmic radiation, particularly during periods of solar flare activity, presents the possibility of gravest danger to astronauts during lengthy flight regimes. Primary approaches towards solution of these problems varied among the scientists, however.

Report presented by Soviet scientists I. M. Volynkin and P. P. Saksonov termed cosmic radiation one of the "main dangers" in space.

"Its great penetrating power makes it next to impossible to protect man from galactic rays," the Soviet report said. Aside from direct physical danger to the astronaut, the report noted, cosmic radiation also might upset the balance of ecological systems of spacecraft by damaging or changing the nature of algae and other fauna placed aboard to help maintain the regenerative process.

Cosmonaut Radiation

The authors noting that relatively low orbital flights appear to present no problems to this area, reported that Soviet Cosmonaut Andrian Nikolayev sustained a total of 30 millirad of radiation during his 94 hr. 25 min. flight in Vostok 3, while Cosmonaut Pavel Popovich registered 40 millirad after 71 hr. in Vostok 4.

The Soviet Union earlier had said that Nikolayev received a dose of 50 millirad and Popovich 36 millirad (AW Aug. 27, p. 37).

Both authors were present at the session, and in reply to questions from the floor said that despite earlier theories elsewhere that chemical and pharmaceutical anti-radiation measures were ineffective against X-rays and gamma rays, later experiments have shown that these measures will provide some, although not total, protection.

Further suggestion was that crew members in periods of danger, such as solar flare activity, might insert themselves into a protective "box" that would augment exterior spacecraft shielding.

Soviet scientists, Volynkin and Saksonov said, can now predict periods of solar flare activity 2-3 days in advance. They added that these periods of projection will be increased in the future.

Prof. N. M. Sissakian, prominent biologist and presidium member of the Soviet Academy of Sciences, said the possibility of solar flares represents the greatest [illegible] danger to astronauts. He added that in the event of increased radiation, Russian space capsules can now be redirected into a re-entry trajectory at any time and point on an emergency basis.

Bioastronautic Research

Sissakian, a co-chairman of the symposium sponsored by International Astronautical Federation and International Academy of Astronautics, outlined, in a report which avoided specifics, five major tasks which he said are presently confronting bioastronautical researchers:

- **Over-all investigation** of long-term effects on man and space components of prolonged periods of weightlessness during space flights.
- **Active cooperation** with design engineers in ensuring that future spacecraft have adequate life support and hygienic systems.
- **Establishment** of adequate medical criteria for crew selection and training techniques.
- **Study of biological** basis for life support system development.
- **Explorations leading** to identification of possible life forms in areas of the universe outside the earth's environment.

Soviet scientists in private conversation here appear to have rejected proposals that man could be effectively protected from radiation hazards by lowering his metabolism rate through reduction in body temperature.

U.S. proponents of such an approach say reduced cellular activity under this condition would substantially reduce harmful radiation effects, because of a lower radiation absorption state as well as trim demands on life support and logistics systems by cutting needs for oxygen and food during these periods.

One approach under consideration in the U.S. would permit the astronaut to lower his own body temperature—probably through a water-cooled, quick-cool method incorporated within his space suit—during dangerous periods of radiation by a simple push-button technique which would trigger the necessary chemical reaction.

This state of suspended animation, some proponents say, probably would be halted automatically by a sensor when sufficient lowering of the radiation count was determined by a control ling monitor system.

A report concerning experiments on this phenomenon, which aroused considerable comment, was delivered by Yugoslav bioastronautical scientist R. J. Anjus of the University of Belgrade's Institute of Physiology.

In a number of experiments ranging in size of test subjects from rats to dogs, a group at the university headed by Anjus found that ground squirrels could occasionally be placed in a state of 0 deg. body temperature and suspended animation for periods of 7 hr. without ill effect.

Squirrels Revived

Anjus said "clinical death" experiments showed that all of the squirrels could be revived after 3 hr. from such a condition and that half of them could be brought back to life after 5½ hr.

In the case of non hibernating rats, all of them could be revived after 1 hr., but none after 2 hr.

Tolerable temperature limits in such tests, he said, are between −6 and −8F. He estimated that man's body temperature can be lowered to a minimum of −10F. U.S. proponents of this approach say the acceptable limit, if adopted for space flights such as the Apollo lunar mission, could be kept well above 0F.

Anjus said his experiments demonstrated that under these conditions test subjects showed increased resistance to lack of oxygen and radiation dangers. His report added:

"Along with its capability of protecting against anoxia, internal cold is capable, below a given level of body temperature, of creating anoxic conditions at the tissue level in spite of a normal or even increased oxygen tension in the ambient air. In the extreme, internal cold, through its basic inhibitory effect on life processes, causes the cessation of oxygen supply and transport (respiratory

Soviet Delegation

Paris—Full Russian 14-scientist delegation to the "Basic Environmental Problems of Man in Space" symposium here appeared on schedule despite the Cuban crisis. Cuban flareup was raging at the beginning of the symposium, and many Western observers felt this might keep the Soviets away.

At the conference, Soviet scientists presented a total of eight reports, the same number as delivered by United States delegates. British delivered four, West Germans three, French two and Swedish two while representatives of Yugoslavia, Austria, Czechoslovakia and Poland presented one each.

and circulatory arrest) At same time, however, through its protective effect, it renders organisms capable of tolerating relatively long periods of such suspended animation."

Anjus, asked by a Soviet scientist if such treatment "might be promising" for space crews, appeared to side with detractors of this approach without giving his reasons.

He said he could not foresee humans or higher mammals being placed in a state of suspended animation, but that it appears promising for use on microorganisms.

The length of time that these can be placed in the region of "clinical death," he added, is unlimited.

Soviet scientists, as they had earlier in talks following the flights of Vostoks 3 and 4, continued to emphasize their concern over possible dangers to man in space during prolonged periods of weightlessness (AW Oct. 8, p. 38). U.S. delegates familiar with the subject agreed with Russian colleagues that, in the words of one, "anyone in his right mind is concerned."

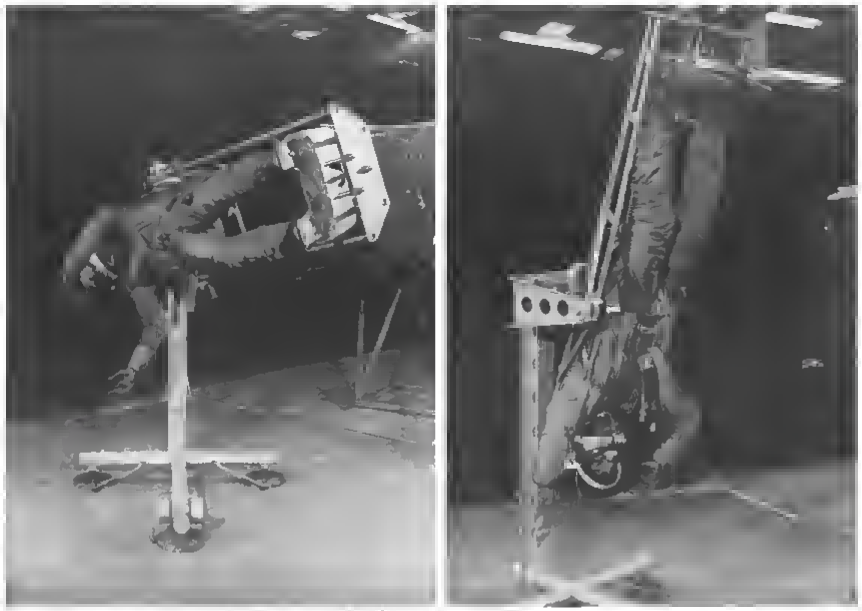
A report authored by three Soviet bioastronautics experts—including Army Col. Vladimir I. Yazdovsky, a prominent figure in the Vostok program—emphasized the "non-pathological character" of physiological reactions to stress factors during orbital flight by Nikolayev and Popovich, as well as Gherman Titov and Yuri Gagarin. The report added, however, that "certain peculiarities which appeared during analysis of the physiological reactions and of a whole range of biological data require further investigation."

The report continued:

"The most important lines for future research are to study the influence of prolonged weightlessness, the biological effects of cosmic radiation, the effects of excess pressure after a period of weightlessness and, of course, to analyze the influence on the organism of the entire complex of space flight factors, including the emotional state."

In his paper, Prof. Sissakian said no dangerous physiological disturbances were detected in either Nikolayev or Popovich during their flights. He later stated that physiological changes observed during the Vostok 3 and 4 flights were in the area of "adaptive responses" and echoed earlier statements by Soviet scientists that flights of up to four days, as evidenced by Vostok 4, apparently present no particular problems.

The presentation by Volynkin and Saksonov noted that prolonged weightlessness could "influence all aspects of human life." It could, they added, decrease man's ability to withstand acceleration forces on re-entry and perhaps influence reaction of all of his motor responses.



GENERAL ELECTRIC five-degree-of-motion simulator is being used to determine how well a crewman can work in the weightless environment of space (see cover). Simulator is designed to provide longer periods of simulation than are possible in aircraft Keplerian maneuvers. In these photographs the pilot is shown simulating free movements in space.

Simulator Aids Space Movement Studies

General Electric Missile and Space Division has put into operation a simulator at its Valley Forge Space Technology Center designed to aid development of equipment for use outside the spacecraft and for training crewmen in maintenance and repair in space.

The simulator (see cover and photographs) consists of three air bearings which provide translational freedom in two directions and yaw in a third. Platform itself is suspended by twin low friction gimbals that providing 360 deg freedom in roll and the other about 110 deg in pitch.

Although this five degree-of freedom device does not fully simulate zero gravity conditions, General Electric said it closely approximates the frictionless conditions which will be experienced in space.

The device called the space worker has been in use since early July. C. R. Cording, project manager, told AVIATION WEEK that studies conducted so far have concentrated on activities which require simple push-pull and torque movements. From these early studies, four broad conclusions have been reached:

- **Special space tools** to perform tasks that are now anticipated will not be required.
- **Crewmen working outside** a space vehicle will become tired more quickly than had been anticipated.
- **Auxiliary propulsion**, such as a rocket belt or pack, will be required if the crewman must leave direct contact with the vehicle.
- **Man adapts very quickly** to using his body properly in a frictionless environment because he quickly learns where to use his own weight as a lever.

When the test subject is restrained on the simulator, his center of gravity is balanced about the rotational axis of the gimbals. He is then free to roll, pitch and yaw and to move backward and forward.

The application of a small force will cause him to change attitude and translation.

The work done so far has been what is considered normal maintenance—turning screws, nuts and bolts, operating switches and valves and drilling holes. With the use of restraint and proper leverage, Cording said, reactionless tools probably will be unnecessary in the space environment.

If it proves true that crewmen will become tired more rapidly than had been thought, size of space crews may have to be increased. Although this conclusion is considered tentative, it supports the theory that oxygen consumption is greater in a weightless condition when the crewman performs complex tasks.

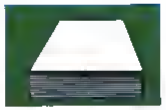
Simulator will be used to determine design requirements for moving the astronaut when he is outside his spacecraft, such as when he assembles structures.

Guidelines, handholds and tethers may be satisfactory when direct contact with the spacecraft is maintained, but individual propulsion systems probably will be needed when contact is lost, Cording said.

ALMAR steels mean combinations of properties

Available in ALL FORMS in both production and development quantities from Allegheny Ludlum

SHEET



Up to 72 inches wide with lengths to suit, just as in stainless steel, is the standard limitation for ALMAR steels. Coiled sheet is available up to 48 inches wide.

STRIP

All standard stainless steel strip sizes can be duplicated in Mar-Aging steels. At A-L, ALMAR strip down to .010" thick has been rolled. Should the demand develop, foil will be available.

Allegheny Ludlum has furnished much ALMAR plate. Actual production has shown that every plate size made in stainless steel can be duplicated in Mar-Aging steels.

PLATE

BARS

In stainless steel, Allegheny Ludlum furnishes every size and shape of bars. In ALMAR steels, Allegheny Ludlum also can furnish every shape and size.

WIRE

Virtually all stainless steel wire sizes can be duplicated with the ALMAR steels. Actual production has taken place down to .010" dia., and experimental wire drawing down to .003 4" dia.

TUBING

Seamless tubing in the ALMAR steels up to 5 inches in diameter is available from Allegheny Ludlum.

EXTRUSIONS

Every shape that can be extruded in stainless steel can be duplicated in ALMAR steels—range up to a shape that can be enclosed in a 5¼" dia. circumscribing circle.

FORGING BILLETS

ALMAR steels are available in the full range of forging billets, as air melted and consumable electrode vacuum melted steel billets.

Yield Strengths of 200-280,000 psi with high ductility—55% to 35% reduction of area.

Tensile Strengths of 210-290,000 psi with real toughness—Charpy impact up to 16 ft.-lbs., down to 420 F.

Fracture Toughness with G_c values over 1,000—at yield strengths up to 280,000 psi.

Simple Heat Treatment at low temperature (900 F age) without quench means low cost and no distortion. Welds can be strengthened by local heat treatment.

Easily Welded—Easily Machined using the same techniques as for any high strength steel.

Super high strengths with good toughness and easy fabrication make Allegheny Ludlum ALMAR steels really unique.

Developed from an International Nickel Company discovery, A-L's Mar-Aging steels are remarkably resistant to crack propagation and possess unusually low work-hardening tendencies. The Mar-Aging steels first existed as 20 and 25% nickel plus titanium steels. Allegheny Ludlum calls them ALMAR 20 and ALMAR 25 steels.

Now, an 18% nickel steel with cobalt and molybdenum offers the best combination of properties plus simplified heat treatment. This ALMAR 18 steel, through minor composition variations, is produced with strengths from 200-300,000 psi.

Unique among the relatively few producers of Mar-Aging steels, Allegheny Ludlum alone offers ALMAR steels in the *complete range* of mill forms—sheet, strip, plates, bars, wire, tubing, extrusions, and forging billets. They may be obtained from developmental or production size heats, air melted or consumable electrode vacuum remelted. Availability of less than heat lot quantities in any particular product form is, of course, dependent upon inventory of finished or semi-finished stock.

It is this total competence with the Mar-Aging steels that makes A-L's producing role unique . . . *all* product forms and production techniques, including continuous cold rolling, *all* strength levels and *all* compositions, together with Allegheny Ludlum's familiarity with *all* areas of Mar-Aging application presently under investigation. This unique experience with the ALMAR steels is at your service.

ALMAR
MAR-AGING STEELS

NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

HEADQUARTERS, WASHINGTON, D. C.

Ling-Temco-Vought, Inc., Dallas, Tex.—$58,000 for determination of optimal environment and shielding against meteorites.

Navy Bureau of Weapons, Washington, D. C.—$50,000 for research on low frequency combustion instability of solid rocket propellants.

U. S. Information Agency, Washington, D. C.—$55,000 for production of English and foreign language prints of film "Friendship 7."

AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.

Maher & Martens, San Francisco, Calif.—$51,000 for architect-engineering services for design of biosciences laboratory.

Ampex Corp., Palo Alto, Calif.—$68,000 for recorder reproducer.

Raven Industries, Inc., Sioux Falls, S. D.—$50,000 for balloon flights.

Ralph M. Parsons Co., Pasadena, Calif.—$60,000 for airborne tape recorders and associated equipment.

Columbia University, New York, N. Y.—$49,000 for design and implementation of physiologic monitoring systems.

LEWIS RESEARCH CENTER, CLEVELAND, OHIO

United Aircraft Corp., East Hartford, Conn.—$152,000 for experimental investigation of heat rejection problems in nuclear space powerplants.

Nichols Corp., Santa Fe Springs, Calif.—$102,000 for services and materials to design, manufacture, test and furnish portable research high pressure hydrogen and helium gas containers including semi-trailers.

Electro Optical Systems, Inc., Pasadena, Calif.—$134,000 for theoretical and experimental research on a steady state hall current accelerator.

General Dynamics Corp., San Diego, Calif.—$115,000 for analytical and experimental investigations to evaluate an optimized coaxial plasma accelerator.

Ling-Temco-Vought, Inc., Dallas, Tex.—$68,000 to redesign Scout payload separation system for increased load and separation velocities.

Pressure Products Industries, Hatboro, Pa.—$54,000 for isostatic pressure system for jet propulsion static test laboratory.

LANGLEY RESEARCH CENTER, HAMPTON, VA.

Cutler-Hammer, Inc., Long Island, N. Y.—$85,000 for lease of equipment and engineering support services.

Ling-Temco-Vought Corp., Hatboro, Pa.—$11[illegible],000 for services and materials for furnishing hydraulic vibration exciter system.

Radio Corp. of America, Camden, N. J.—$2[illegible]4,000 for designing, furnishing, installing, testing, placing in initial operation and demonstrating performance of a lunar orbit and landing approach simulator.

Navy Bureau of Weapons, Washington, D. C.—$54,000 for rocket motors, X2[illegible]8B1.

Army Ordnance Missile Command, Redstone Arsenal, Ala.—$129,000 for Castor rocket motors, XM33E7.

Navy Bureau of Weapons, Washington, D. C.—$84,000 for X254A1 rocket motors.

GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

Bendix Corp., Teterboro, N. J.—$449,000 to design, fabricate and test prototype model and flight model of a gimbaled star tracker with electronic scan of field of view for OAO stabilization and control subsystem.

Vector Manufacturing Co., Southampton, Pa.—$92,000 for transistorized FM telemetry transmitters.

Corning Glass Works, Corning, N. Y.—$81,000 for quartz lenses.

Dynasil Corp., Berlin, N. J.—$55,000 for quartz lenses.

Angus Stoner Associates, Silver Spring, Md.—$62,000 for diodes and transistors.

Ampex Corp., Washington, D. C.—$104,000 for instrumentation tape recorder.

Omnitronics, Inc., Philadelphia, Pa.—$51,[illegible] for high speed bi-directional paper tape reader and reeler.

Collins Radio Co., Dallas, Tex.—$2,506,000 for re-fit antenna systems.

Computer Control Co., Framingham, Mass.—$89,000 for assorted digital modules.

Computer Control Co., Framingham, Mass.—$51,000 for [illegible] transistor circuit modules, high speed stack and plug-in digital modules.

MANNED SPACECRAFT CENTER, HOUSTON, TEX.

Texas Instruments, Inc., Dallas, Tex.—$71,000 for research and development for elapsed time code generators.

Ling-Temco-Vought, Inc., Anaheim, Calif.—$68,000 for random motion equalization system.

Hi-Speed Equipment Co., Waltham, Mass.—$71,000 for 16, 35 and 70 mm processing machine, Model FR404.

Aerojet-General Corp., Sacramento, Calif.—$760,000 for rocket motors for solid suborbital vehicles.

Cross Construction Co., Houston, Tex.—$87,000 for rehabilitation of buildings 230, 240 and 383 at Ellington AFB.

General Dynamics Corp., San Diego, Calif.—$900,000 for airframes for solid suborbital vehicles.

Ling-Temco-Vought, Inc., Anaheim, Calif.—$237,000 for transistorized low level dc amplifiers.

Air Force Systems Command, Tullahoma, Tenn.—$2[illegible],000 for wind tunnel test in support of Apollo project.

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

Giannini Controls Corp., Duarte, Calif.—$50,000 for design, development and fabrication of digital force balance pressure transducer.

Texas A&M Research Foundation, College Station, Tex.—$[illegible],000 for investigation to establish low level turbulent wind definition in terms of usual micrometeorological parameters.

FIVE-VEHICLE SERGEANT MISSILE CONVOY moves into firing position over typical combat area terrain. Launcher-erector leads, followed by motor and guidance section mover, warhead transporter, organizational maintenance test station and (partly visible) field maintenance test station. Typical battalion has two batteries and a total of six missiles.

Army Fires Sergeant as Field Use Nears

By Erwin J. Bulban

White Sands Missile Range, N. M.—First firing of a tactical configuration Sperry SSM-A-21 Sergeant surface-to-surface missile here under complete control of a U. S. Army artillery unit culminated in the ballistic missile impacting in the target CEP (circular error probability) after a maximum-range flight of slightly over 75 naut. mi.

Lt. Col. Frederick Spann's 3rd Missile Battalion (Sergeant) 38th Artillery, overcame several technical holds to launch the weapon and boost its CEP record. Six previous firings in the engineering service test series here, utilizing contractor assistance, had resulted in three of the missiles impacting the target area, meeting an Army requirement that a system register within the CEP at least 50% of the time.

The battalion had completed two earlier demonstrations the same day. Immediately in front of an audience of high-ranking Army observers and contractor personnel the battalion drove into the area, positioned itself, erected the weapon and was ready to launch within a half-hour, performing every step necessary to the mission.

It also participated in an air transportability demonstration, that had to be revised when the Lockheed C-130 Hercules that was to airlift the launcher to the demonstration site became unavailable due to the Cuban missile base crisis (AW Oct. 29, p. 26-34). The problem was simulated in front of the stands using planking and the 8.5-ton erector-launcher—heaviest portion of the system—was moved out of the mock-up plane and hooked up to its prime mover in approximately 7 min.

Successful first firing of Sergeant by a tactical unit here was indicative of near-combat readiness of the system. Army has two additional units in training: the 3rd Battalion of the 81st Artillery and 5th Battalion of the 77th Artillery, and plans to begin deployment of Sergeant overseas early next year.

In addition, it is training the first West German army missile battalion at Ft. Sill, Okla., to operate the Sergeant systems purchased by that government to meet its agreed North Atlantic Treaty Organization commitments which call for deployment of this missile in Germany by early 1963. Deployment schedules are based on planning performed earlier this year. Indications are that the system could be fielded much sooner should it become necessary.

West German purchase of Sergeant is the first officially announced foreign government purchase, but industry observers say that at least two other NATO partners are currently discussing adding the system to their inventories.

Germans are funding the purchase entirely. No U. S. money is involved. Any nuclear warheads assigned the unit will remain under U. S. control. Purchase agreement was concluded when Deputy Secretary of Defense Roswell Gilpatric visited Germany two months ago.

These milestones are the culmination of a development program initiated in 1955 by California Institute of Technology's Jet Propulsion Laboratory for the Army on an advanced ballistic missile system to replace Corporal, which had reached an operational state a year earlier.

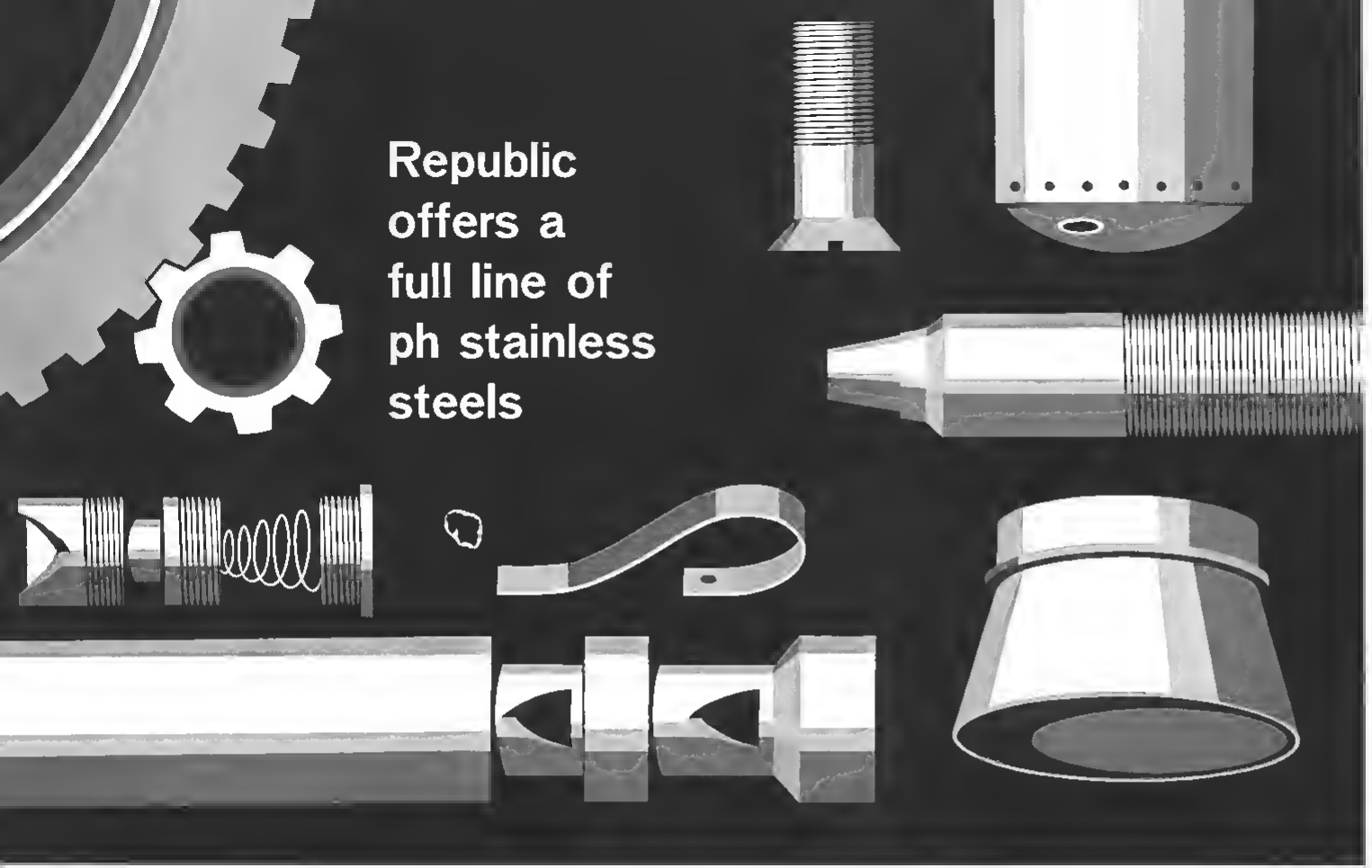
This follow-on, second-generation artillery system was to take advantage of the lessons gained in development and deployment of Corporal. The system, however, would not merely be an improvement but represent advancing the state of the art and providing a completely new system whose only resemblance would be that it would handle the same mission.

SSM-A-21 would incorporate extreme reliability, immunity to electronic countermeasures, ruggedness, cross-country mobility exceeding that of heavy artillery, rapid emplacement and displacement and simplicity of operation and maintenance.

In 1956, Sperry Gyroscope Co., N. Y., was selected as co-contractor to

SINGLE-STAGE, 45,000-LB.-THRUST solid propellant motor is first fitted to launcher by three hooks, above left. Guidance package, containing inertial platform, next is moved into position and mated to motor by four swing-bolts, above right.

NUCLEAR WARHEAD IS MATED last after being checked in container. Above right, interchangeable tail fins are snapped in place. Sergeant has been assembled in seven minutes under field condition by six men. With missile complete, below, cable is hooked to launcher and checkout completed. Firing data is inserted in fire direction center, left, on the launcher.



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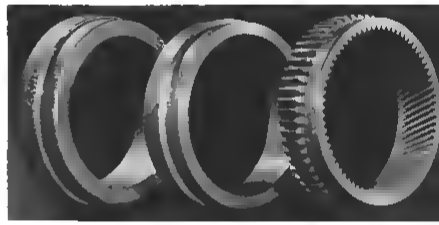

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FIRING SET OPERATOR leaves fire direction center three minutes before launch and monitors countdown on hand held control box. Missile turns to proper azimuth and elevates 75 deg 80 sec before launch. Missile fires automatically

work with JPL for research and development and as prime contractor for follow on industrial production. Sperry acquired a 46-acre site near Salt Lake City Airport, Utah, and erected a 50,000-sq ft facility to handle engineering development and production of prototype missiles, staffed with about 200 personnel, mostly transferred from Great Neck, L. I.

Weapon Characteristics

Late in 1959, JPL was withdrawn from the program to devote its efforts to the national space program and Sperry assumed sole prime contractor responsibility for the Sergeant system.

Basic characteristics of the new weapon system were worked out by JPL and Sperry Utah under the guidance of Army Ordnance Missile Command (now Army Missile Command), Huntsville, Ala. These resulted in Sergeant equaling Corporal's range and firepower but having these significant advantages:

- **Sergeant solid-propellant motor** shortens reaction time from mission assignment to launch by hours and requires less than half the ground-support equipment of the liquid fueled Corporal.
- **All-inertial guidance system** is protected against any known enemy electronic countermeasures and eliminates need for ground equipment needed in Corporal for its radio command type guidance.
- **Increased mobility** through the use of more rugged system components—the entire Sergeant system can be moved over any terrain traveled by Army's current heavy trucks and trailers.
- **Rapid field maintenance** by relatively unskilled personnel is made possible by use of plug-in pull-and-replace components and assemblies which are positioned for easy access.
- **Checkout and countdown** are completely automatic.

Tactical configuration Sergeant measures approximately 34.5 ft long and 31 in. in diameter and weighs approximately 10,000 lb with the warhead weighing about 1,600 lb. The missile is primarily a nuclear fire support system with a secondary capability of delivering both chemical and biological warheads—it has no high-explosive capability, according to Army doctrine.

Nuclear Posture

Tactic is to deploy the Sergeant on the battlefield ready for use in nuclear war. Even if initial phases are conducted with non-nuclear weapons, Sergeant would maintain a posture that would permit reaction to obtain nuclear superiority by suppressing the enemy's nuclear artillery, nuclear ammunition supply points, control centers associated with nuclear delivery means and air defense artillery sites. After nuclear superiority has been obtained, the Sergeant would be diverted to attack other targets.

SSM-A-21 Sergeant will be assigned and allocated in the same manner as the Corporal system, that is, to the field Army and made available to the corps commander by attachment or mission assignment. Current planning calculates providing for allocation of three Sergeant battalions per field Army, although actual combat conditions in the field could vary this program considerably.

Sergeant marks a departure from the battalion fire unit concept under which all first-generation missile systems were organized—two missile batteries, each with a launcher and three rounds, including a training missile, providing the supported force commander with continuous fire support, regardless of displacement requirements. Weapon's range provides considerable elasticity in placement and targeting comparable to that available in previous wars to the Air Force.

New shoot-and-scoot weapon system is comprised of five major mobile equipment items—the erector-launcher, the organizational maintenance test station (OMTS), the field maintenance test station (FMTS), the motor and guidance transport trailer and a standard M-35 truck carrying the warhead.

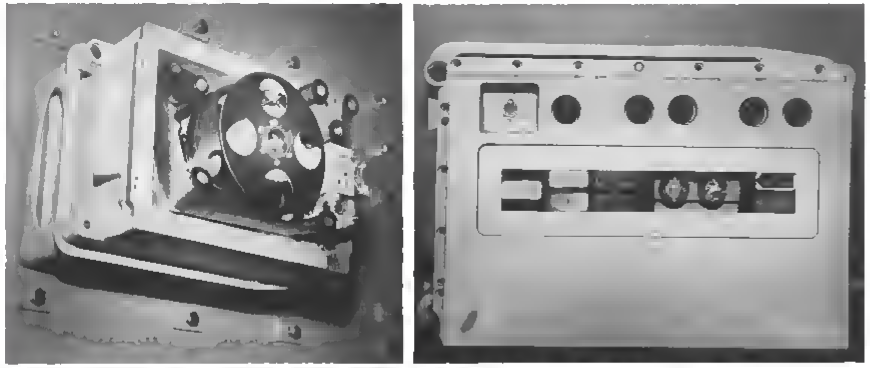
System is designed to simplify field positioning requirements. The entire battery can be placed in an area 1,000 ft in diameter, with the erector-launcher needing a cleared area of 60 ft in diameter to emplace it and provide room for the missile component transport vehicles to unload in succession.

The OMTS requires the same clear area.

System Operation

After the erector-launcher has been positioned, its prime mover is detached and may head for cover. The launcher can be positioned on terrain with a slope of 1/10, having two outriggers that are extended, each with a 3,000 psi raising and leveling hydraulic jack, plus a third jack in the center of the rear base operated from a control panel on a fender.

Circular dish-shaped aluminum blast shield is hinged with firing position by



TAPES ARE USED to check each Sergeant missile section and component as it is assembled and to isolate problem areas automatically. Control panel right uses push button controls to provide go-no go indication and numbers indicate faulty assembly

hand operated hoist—weighing less than 200 lb—it can withstand 50,000 lb thrust force. The launcher boom is extended, a section of this being folded down to serve as the pick-up for the missile's main components. An operator sits on the superstructure, controlling the loading operation by swinging the launcher boom up to 356 deg., if required, using electro-hydraulic power to lift each section out of its container and move it rearward where the assembly crew guides the components together and locks them using fast-action swing bolts.

Components Checked

Prior to the vehicles carrying missile sections departing to the launcher each component is checked out by plugging them into the OMTS for test. These procedures are handled without opening the waterproof containers. Should a failure be detected during this automatic checkout process which isolates the faulty assembly, the entire section is lifted out using a crane on the OMTS. The assembly is replaced and a retest performed.

Sergeant missile is made up of four major sections—the warhead section, the guidance section consisting basically of an inertial platform, a computer and control assembly, the single-stage Thiokol solid propellant motor of approximately 45,000 lb thrust and associated ignition circuitry, and four control surfaces.

Assembly procedure, which has been accomplished by six men in seven minutes, places the motor in position on the zero launcher first, hanging it on and locking it by three hooks. The guidance section follows, attaching to the motor with four quick-connect swingbolts. The warhead is then lifted into position and secured to the guidance section with four swingbolts, and finally, each of the four fins are lifted up, snapped into place and locked.

Following assembly, electrical cables are hooked up, connecting the system to a 110 shp gas turbine mounted on the launcher, and providing 40 kva. 400-cps., ac power to activate the guidance system, programmer and associated electronic equipment. It also powers the freon cycle refrigeration system that protects the electronics against heat build up during countdown. A similar gas turbine generator system provides power for the launcher's electro-hydraulic actuating system. During an average launch, each of the turbines consumes 6.7 gal. of the same combat fuel used by the transporting vehicle.

Sergeant Contractors

Prime contractor—Sperry Utah Co., Division of Sperry Rand Corp.
Program manager—Army Missile Command, Redstone Arsenal.
Air brake actuators—Adel Precision Products.
GTP70 gas turbine generators—AiResearch Manufacturing Division, Garrett Corp.
3G52 & 3G100 field training system and classroom training system—Aircraft Armaments, Inc.
Accelerometers—Bell Aerosystems Co., Bell Aerospace Corp.
Illustrated parts catalogs—Butler Publications.
Guidance system synchro transmitter—Farrand Controls, Inc.
Transport trailers & firing station enclosure—Fruehauf Trailer Co.
Ground handling equipment—Hanson Bros., Inc.
Technical manuals—Kirk Engineering Co.
Guidance-fin servos—Power Equipment Division, Lear Siegler Inc.
Inertial guidance system gyros & warhead—Minneapolis-Honeywell.
Rocket motor cases—National Electric Division, H. K. Porter Co.
Telemetry subcarrier oscillators—Vector Manufacturing Co. Inc.
Magnesium cast fins—Southgate Aluminum & Magnesium Co.
Motors—Thiokol Chemical Corp.
Erector-launcher—Ling-Temco-Vought.

Missile Firing Set

Also located on the erector-launcher is the missile-firing set. This small enclosure houses equipment capable of accepting firing data, generating firing parameters and inserting them in the missile, checking its computations and controlling the 20-min. automatic countdown and automatic firing. First 24 min. of the 44 min. countdown are not automatic. Simultaneously it continuously monitors Sergeant readiness during countdown by making go-no go checks. All firing set operations are automatic after target and firing data are inserted into the control panel by the operator, missile assembly and receipt of firing data being completed concurrently.

Firing set operator completely self-tests the equipment and inserts the mission data. Should a malfunction occur in the firing set, the operator can either pull the component and replace it with one from an identical bank on the opposite wall, or continue the mission using the alternate bank.

At X minus three minutes, the operator evacuates the firing set, taking with him a remote control unit to monitor the remainder of the countdown from a position 250 ft. away.

This remote control unit provides him with the ability to override or stop the firing sequence at any time. The firing set maintains capability of setting up an automatic hold should a malfunction occur during countdown.

At X minus 85 sec., the Sergeant elevates five degrees, five seconds later, the launcher slews it to the proper azimuth and elevates it to 75 deg.

After launch, the Sergeant trajectory has three phases. An initial phase starts at "fire" and continues until motor burnout—the 6,000 lb. of propellant is always completely expended regardless of whether the missile goes 25 naut. mi. or its full 75-naut. mi. A mid-course maneuver begins at motor burnout and lasts until the start of the final pitch-down maneuver. This maneuver carries missile to the target and lasts until impact of the complete missile.

Motor burnout is accomplished in approximately 30 sec. after launch. Trajectory depends upon range—varying from a peak altitude of 13 mi. for minimum range of some 25 naut. mi. to a 27 mi. peak altitude on the maximum range of about 75 naut. mi. Trajectory is accomplished by comparing actual course with a preflight programed trajectory.

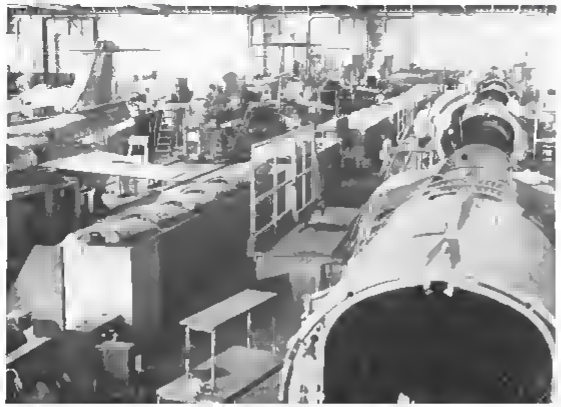
During the demonstration launch, two holds of a non-tactical equipment nature were encountered, each related to telemetry instrumentation fitted to the Sergeant to provide additional tracking data during the shot. A faulty light on a control panel monitoring the telemetry gear gave two false signals indicating malfunctions in the gear and the countdown was held up briefly each time while the problem was traced.

Speed is supersonic, in excess of 2,000 mph. Range is controlled using full-opening drag brakes hydraulically extending from the missile body on command from the programmer to vary speed as necessary to meet the mission objective.

Sergeant construction includes aluminum alloy warhead, the section being explosive-formed and then welded into the required conical shape. Guidance section also is of aluminum construction, being a sheet-metal torque tube with longerons carrying the loads. Motor case is a thin-wall steel component, made up of three cylinders welded in a single pass longitudinally and circumferentially. Fins and control surfaces are of magnesium construction, using one-piece sections molded utilizing a sand process. The internal portions are cored-out.

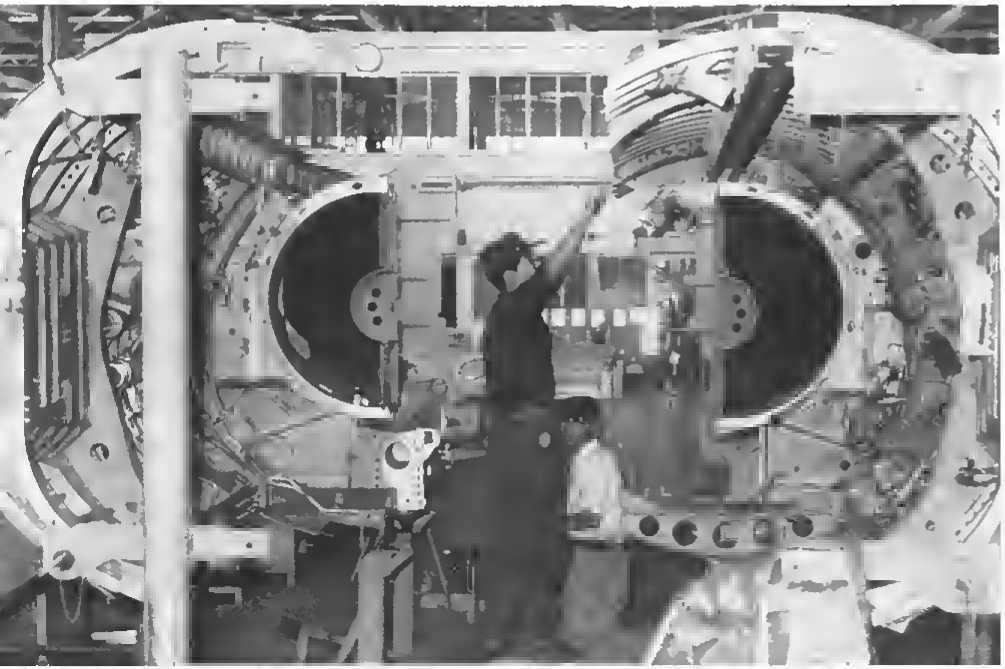
Army acknowledges that thus far there is a total of $500 million invested in the Sergeant program, including all development costs and production purchases to date and that the cost of outfitting a battalion with all of its equipment, including the missile, now runs approximately $7.5 million.

SERGEANT missile launched by 3rd Missile Battalion of 38th Artillery takes off from launch site at White Sands Missile Range, N.M. Guidance vanes are visible projecting into exhaust stream of Thiokol solid-propellant motor. Missile impacted on target slightly more than 75 naut. mi. away. Entire Sergeant missile re-entered without warhead separation.

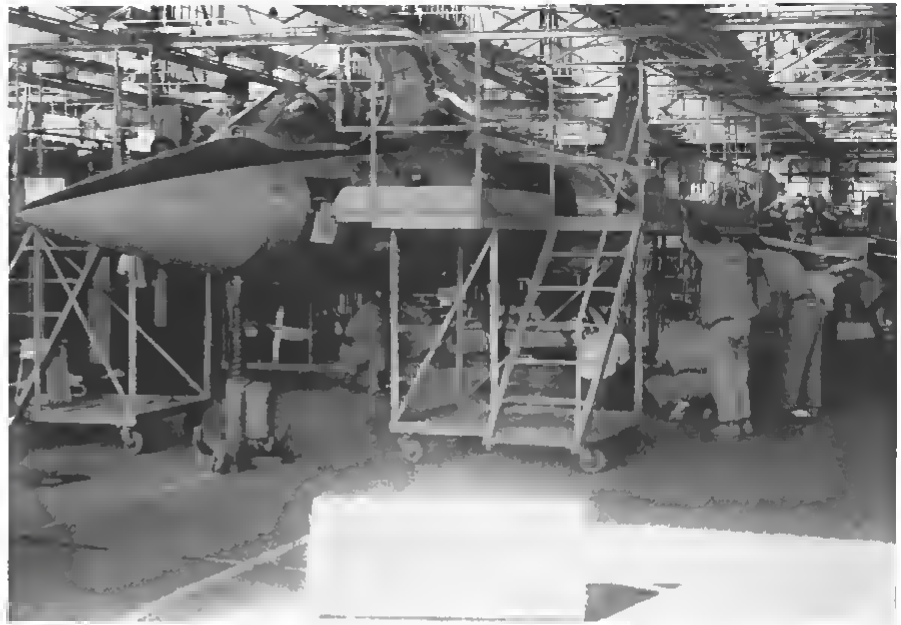


Assembly of 177 F-104J fighter aircraft in Japan has begun at three Japanese plants and engines are being assembled at a fourth. Twelve F-104Js are in final assembly at Mitsubishi's Komaki plant, above right, and at least five already are flying. Gifu plant of Kawasaki Aircraft Co., Ltd., above left, assembles empennage (shown), forward fuselage and aft sections.

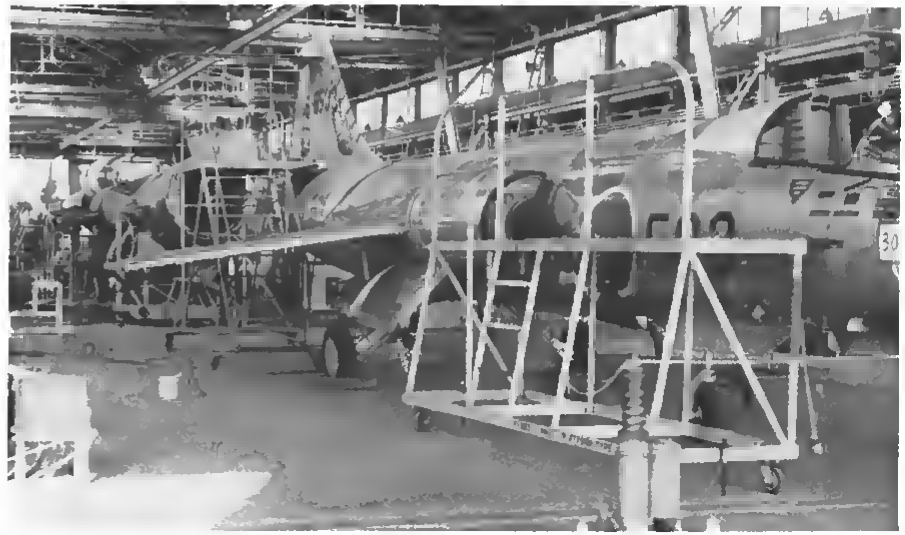
Japanese Begin Assembly of 177 F-104J Fighters



Mid-fuselage for the F-104J is assembled at the Oye plant of Mitsubishi, above, prior to mating with other subassemblies at the Komaki plant (AW Nov. 5, p. 40). First all-Japanese Starfighter is scheduled for delivery in January. Lockheed-California is building 23 F-104J and F-104DJ aircraft for the Japanese, to make a total of 200 for the Japanese Air Self Defense Force.



Landing gear of an F-104J is tested at the Mitsubishi Komaki plant, above. Below, fuselage sections are mated on the final assembly line at the Komaki plant. Ishikawajima-Harima Heavy Industries Co., Ltd., assembles the J79 engines for the aircraft. All 177 Japanese-built F-104J fighter aircraft currently are scheduled to be completed by January, 1965.



South Vietnamese aircraft practice close air support techniques above, in what USAF describes as a training exercise prior to counter insurgency strikes against the Viet Cong. Aircraft appears to be a T-28.

Vietnamese Train for Anti-Guerilla Air War

Two T-28 aircraft in USAF markings fly over South Vietnam during training mission against the Viet Cong. Below, an AD-6 of the South Vietnamese Air Force is ready for a counter insurgency mission. Note mixed load of fragmentation bombs and rockets in launchers as well as gun which is located under starboard wing of the aircraft

Vietnamese paratroops, above, prepare to board USAF C-123 prior to a training drop being conducted as part of the U. S.-led training program. Below, right, troopers check equipment before boarding aircraft and below, left, await jump signal at the aircraft door. Air field, in above photograph, appears to be constructed of steel mat twg. Note the C-47s in background of top photograph.

Fiber Optic Device Recognizes Signals

By Philip J. Klass

Washington—Small device made up of hundreds of vibrating optic fibers which can program itself to recognize a complex audio signal, to discriminate between different spoken words or to detect a sonar target buried in noise has been developed by Sperry Gyroscope Co.

One of the experimental devices, occupying a volume of one cubic inch, has the ability to store and recognize 300 complex audio frequency signatures, and further size reduction is possible. In production, the cost is expected to be low.

Sperry calls the device a "Sceptron" (pronounced "seption"), an acronym derived from Spectral Comparative Pattern Recognizer. The device was demonstrated and its principles of operation were explained here by Robert D. Hawkins of Sperry at the recent Office of Naval Research symposium on optical processing of information.

Complex Signal

Sceptron not only performs a function that would require hundreds of conventional filters and a large storage capacity, but it can program itself to recognize a complex signal without detailed knowledge of its characteristics.

Device consists of an array of several hundred, or thousand, optic fibers with a diameter of 0.001 to 0.01 in. One end of the fiber is imbedded in a block and the other is left free to form a cantilever beam. The array has a superficial resemblance to an ordinary toothbrush. Clearance space around each fiber permits it to vibrate as a cantilever independently of the others. The choice of fiber length and diameter determines its natural frequency.

To excite these fibers an electromagnetic loudspeaker-type voice coil or piezoelectric transducer is mounted under the array. When a signal in the audio region is applied to the transducer, the unsecured ends of some but not all of the fibers will vibrate. Which of the fibers vibrates depends upon the frequency (or frequencies) present in the input signal and the natural frequency of the individual fibers. The magnitude of their vibration is a function of the amplitude of the signal.

A light source is located behind the block which secures one end of the fibers. Its illumination travels down the length of each fiber and emerges from its unsecured tip. The array of unsecured tips faces a small photographic mask behind which is a photodetector cell.

Basic (static) mask is prepared initially by placing an unexposed film in position facing the array of fiber tips with no signal applied to the transducer and the tips in their neutral position. Light emanating from each fiber tip will create a black dot opposite each tip position when the film is developed. Elsewhere the negative will be transparent.

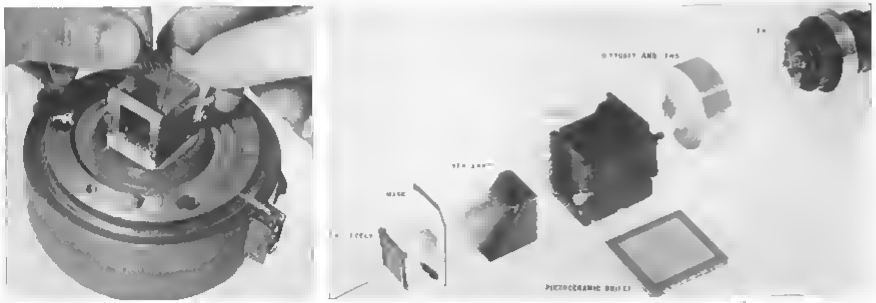
When this processed static mask is installed between the tips and the photocell, light from the fiber tips will be blocked from the photocell by the black dots, so long as there is no input signal applied to the transducer. However, when a signal is applied, causing some of the fibers to vibrate, then light will be transmitted through the translucent portions of the mask and impinge on the photocell.

Signal Storage

To use the Sceptron to detect the presence of a desired signal, or its absence, a similar procedure is used to produce a mask of the signal of interest. An unexposed piece of film again is placed in front of the array of fiber tips and the signal of interest is impressed on the transducer. This sets the fiber tips to vibrating in response to the frequency and amplitude of the impressed signal.

As the fiber tips vibrate, their pinpoint beams of light will expose a trace which, when developed, produces a corresponding opaque area.

If this developed mask is now inserted in the Sceptron, when the same signal is impressed on the transducer causing the fiber tips to trace the same path, none of the light emanating from the tips of the beams will penetrate the mask. However, if a signal of different frequency is applied a different group of beams will be set to vibrating and some of their light will penetrate the transparent portions of the mask to produce an output signal from the photocell. The amount of light that passes through this type of mask called a "rejection mask" is a measure of the difference between the programed (desired) signal



SPERRY SCEPTRON, new optic fiber device, can program itself to recognize the spoken word or other complex audio signal. Assembled device left, atop loudspeaker-type driver is shown having photographic mask inserted which enables it to recognize the desired signal. Exploded view, right, shows an array of hundreds of thin optic fibers which vibrate in resonance with the signal. When desired signal is provided, light emerging from the fiber tips passes through the photographic mask to a photocell. Otherwise light is blocked by the mask. The Sceptron performs a function normally requiring several hundred conventional filters and a large storage capacity and can program itself to recognize complex signals without detailed knowledge of their characteristics.

and the one currently applied to the transducer, Hawkins said

If a maximum signal is desired when the impressed signal matches the programed signal then an 'acceptance mask' is used This is a combination of the static mask and a negative of the rejection mask so that the desired trace area is transparent while all other portions of the mask are opaque

Word Recognition

Hawkins demonstrated the use of a Sceptron for word recognition at the ONR conference here Prior to the conference, Sperry had prepared an acceptance mask for the word "five" When the speaker whose voice had been used to make the mask counted from one to 10 a light flashed each time he uttered the word 'five' The speaker tried to deceive the Sceptron by uttering similar sounding words such as "fine" but it did not respond incorrectly

Particular Sceptron employed contained about 700 fibers responsive over the frequency range of 250 to 5,000 cps More than half of the fibers were sensitive in the 250 to 1,200 cps range which tends to de-emphasize the sounds in the upper portion of the spectrum, Hawkins said

If it were desired to make the Sceptron responsive to the voices and pronunciations of 10 different speakers all 10 voices would be used in the original mask preparation, Hawkins said

To compensate for variations in volume level from utterance to utterance of any given word, Sperry used a second Sceptron containing a static mask The ratio of the output from the static mask unit to the programmed unit output was fed into a ratio detector to determine when the programmed word had been spoken Where multiple syllable words must be recognized, several Sceptrons may be required in series to analyze each syllable

Previous experiments in recognition of spoken words have broken down even single syllables into a series of segments which are analyzed in time sequence to avoid the necessity of using an unwieldy number of band-pass filters

In sharp contrast, the Sceptron is able to perform spectral measurements on an entire word as an entity in real time Hawkins says It is capable of making thousands of frequency domain measurements simultaneously

Since all phases of the input signal contribute to fiber motion, the device can discriminate between signals which are outwardly similar but have subtle differences Hawkins concedes that a large number of abrupt shifts in the spectral content of a signal to be recognized will require more than one Sceptron unit However, because of the high density filtering and storage achievable in the Sceptron, such capacity can be achieved within modest space limits

Spoken Word

Because the spoken word contains much extraneous information about the speaker the particular use of the word in the sentence and the physical environment in which the word is spoken, it is one of the most difficult types of signals to distinguish Hawkins said

In the belief that much more can be learned about the Sceptron and its capabilities with more readily controlled and understood signals, Sperry is currently conducting other types of recognition tests

One of these experiments involves the use of the Sceptron to recognize printed letters and other visual images

In these experiments, the image to be recognized is scanned with a single photocell covering the field of the image The signal waveform characteristic of the image is then produced and used to prepare a mask Hawkins says that the very large information capacity of the Sceptron suggests that it may find use in recognizing hand-printed and hand-written characters which heretofore have been extremely difficult to handle with conventional automatic reading devices

Hawkins points out that the accept-

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Styroflex® coaxial cable was selected for this Navy "Spasur" station because of its outstanding transmission line qualities and great adaptability. These same qualities make this semi-flexible, low-loss, high frequency cable ideal for a number of commercial, industrial and national defense uses.

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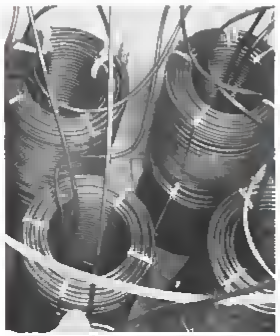
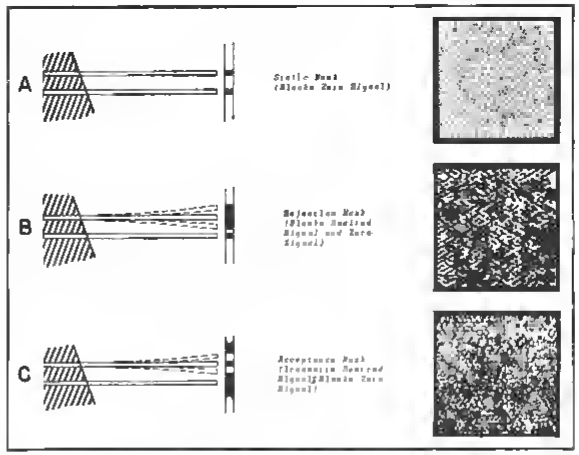


PHELPS DODGE ELECTRONIC PRODUCTS
CORPORATION
300 PARK AVENUE, NEW YORK 22, N.Y.



SCEPTRON OPERATION is shown. Static mask (A) is made with no signal applied to driver fiber tips at rest. Light from tips produces black spots on film when negative is developed. Rejection mask (B) which gives no photocell output in presence of desired signal is made by applying desired signal, causing appropriate fibers to vibrate and their light to create corresponding black areas when film is developed. Acceptance mask (C), which transmits desired signal but blocks others, is combination of static mask and a reversal (positive) of rejection mask.

ance and rejection masks do not have to consist of black and transparent areas. It is possible to have gray areas on the mask which result from limited exposure to light from a fiber tip. Under such conditions the mask would approximate the transfer function of the input signal. That is, a gray area on a positive-type mask would multiply the received light as a function of the stored signal. If the mask is a negative type, then the gray areas would in effect divide the received light as a function of the stored signal.

In experimental Sceptrons built to date, Sperry has tried glass and quartz optic fibers, ranging in lengths from 0.1 in. to 1 in. and major diameters ranging from 0.001 in. to 0.01 in. Most experiments have used fiber arrays of about 700 fibers in a ¼ x ¼ in. face array. The company has built an array of about 1,000 fibers in a face area of only 0.03 sq. in., Hawkins said. The fibers in this array are sensitive to frequencies in the range of 5 kc to 20 kc.

As a cantilever beam, the optic fibers vibrate at two additional frequencies beyond the fundamental—6.36 and 17.53 times the fundamental which gives each three ranges of sensitivity. Additionally, because it is not possible to manufacture such tiny fibers with perfect symmetry about their longitudinal axis, each will vibrate along two orthogonal axes with slightly different resonant frequencies in each direction.

Hawkins says that at the lower end of the frequency spectrum it is fairly easy to produce fibers with resonant frequencies of 100 cps, and with more difficulty they can be produced with resonant frequencies as low as 30 cps.

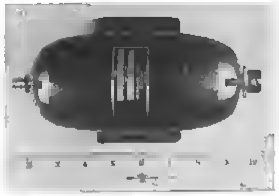
Bandwidth of each fiber depends upon its mechanical "Q," which varies with the material used and the base material in which it is imbedded. Typical values of "Q" are about 125 at 200 cps and about 500 at 5,000 cps.

Single large electromagnetic transducer can be used to drive hundreds of Sceptron units stacked adjacent to one another. The piezoelectric type driver has the advantages of good linearity over the frequency range, low cost and ruggedness. But its high impedance requires a high-level input signal which is a disadvantage in some applications.

Moving coil-type electromagnetic transducer has low impedance and power requirements, but its physical displacement falls off about 12 db per octave for constant voltage input. Thus it requires the use of an equalizing network to assure linearity over a wide audio frequency band, Hawkins says.

Sperry has used photo resistive type cadmium sulfide cells as the detector in Sceptrons built to date. These exhibit time constants of 40 to 400 milliseconds depending upon the intensity of the light source used to illuminate the optic fibers. In future models, Sperry expects to achieve a higher packing density which will increase illumination density on the cell and reduce its time constant.

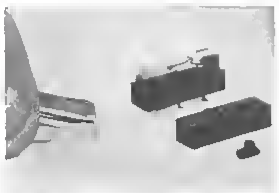
NEW AVIONIC PRODUCTS



• **X-band backward-wave oscillator,** permanent magnet focused Type HO 23, operates over frequency range of 8 2 to 12 4 gc (kmc), provides 50 mw minimum power output Helix voltage is 1,200 v Tube weighs 9 lb, measures 3¾ in dia x 8¼ in long, is priced at $1,300 and requires no cooling Huggins Laboratories, Inc., 999 East Arques Ave., Sunnyvale, Calif

• **Tri-axis accelerometer,** strain gage type No 4 204, measures acceleration along three mutually perpendicular axes Device is available with accelera-

tion ranges of ±5g to 500g Cross-axis response is less than 0 01g per g for ranges through 100g, according to manufacturer, and linearity and hysteresis do not exceed 0 75% of full range output for each axis Accelerometer weighs 7 oz., measures approximately 2 2 x 2 3 x 1 8 in Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif



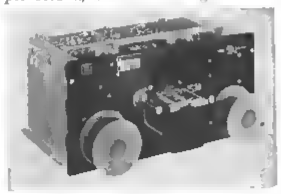
• **Cricket switch,** snap-action type with differential travel of only 0 0005 in between open and close position, requires only 2 oz or less operating force, according to manufacturer Price is $1 15 in quantities of 100 or more Fansteel Metallurgical Corp., Electrical Contacts and Specialties Div., North Chicago, Ill

• **Magnetic field probe** for determining direction and density of fields in alternating magnetic fields The probe is

used with a c vacuum tube voltmeter and conversion formula to determine rms gauss reading Perfection Mica Company, Magnetic Shield Division, 1322 No Elston Ave, Chicago 22, Ill

• **Rare-earth glass laser rods,** with pumping requirements as low as four joules and emission at 1 06 microns, are available in cylinders or bars in lengths from one to 12 in, in diameters of ¼ to 1 in Dielectric coatings reflect 100 pc of radiation from one end of rod and about 98% from other Eastman Kodak Co, Special Products Sales, Rochester 4, N Y

• **Photoelectric tape reader,** Model 7109, for synchronous or asynchronous operation at speeds up to 100 frames per second, available in eight or 16-

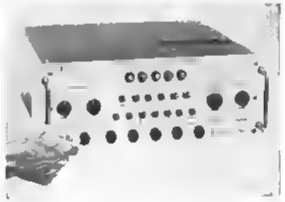


channel configurations, can be stopped on a single character or tape direction reversed upon command Tape reader is designed to operate over temperature range of −40F to 160F, under vibration of up to 5g at 5 to 500 cps and 15g shock of 11 milliseconds duration Tape reader measures 16 x 14 x 8 3 in, weighs 35 lb and can handle up to 250 ft of tape Honeywell Ordnance Division, Seattle Development Laboratory, 5303 Shilsole Ave NW, Seattle 7, Wash

• **Miniature digital encoder,** Type RI-12M, one of new line of optical shaft position encoders and pulse tachome

ters, in size 15 synchro case (1½ in. dia x 1 in. long), with up to 4,096 counts per revolution. Models are available with single or bi-directional counting and with zero reset. Output is 100 mv into 10,000 ohm load. Wayne-George Corp., 322 Needham St., Newton 64, Mass.

• **Telemetry calibrator,** model TMC-505, generates five calibration frequencies equally spaced from center frequencies of 18 standard IRIG channels



and maintains them to an accuracy of ± 0.002% over many months. The calibrator can measure subcarrier discriminator linearity on all IRIG FM/FM telemetering channels simultaneously in seconds, and can serve as secondary frequency standard for data reduction. It can be housed in a 19 × 7 × 18 in. rack space. Manufacturer: Panoramic Electronics, Inc., 520 S. Fulton Ave., Mt. Vernon, N.Y.

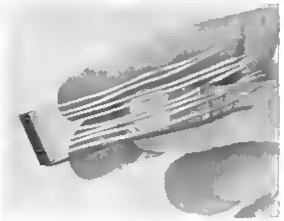
• **Traveling wave tube,** model WJ-237, a medium power, periodic-permanent magnet focused tube designed for satellite transmitter applications has over-all efficiency including heater power from 23 to 27%. Predicted lifetime in satellite environment is 70,000 hr. Manufacturer: Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif.

• **Xenon flash tube,** model FC-47, can supply 10,000 joules of energy over a continuous spectrum from infrared to ultraviolet and is especially deigned for exciting lasers. Tube has an arc length of 6.5 in. and requires 4 kv (1,250 microfarads) for maximum efficiency. Manufacturer: Edgerton, Germeshausen & Grier, 160 Brookline Ave., Boston 15, Mass.

• **Transistor protector,** providing both current and voltage protection, contains Microfuse in a three-terminal stud suitable for mounting on printed circuit board Transistor or diode, connected between two of the three terminals, in combination with fuse provides both over-voltage and over-current protection Littelfuse, Inc., Des Plaines, Ill

• **Subminiature inductor,** 0 1 in dia x ¾ in long, in epoxy molded envelope with radial leads suitable for cordwood type construction, is available in 49 values ranging from 0.10 to 1,000 microhenries for operation over the temperature range of —55C to 125C at altitudes up to 70,000 ft Manufacturer is Nytronics, Inc, 550 Springfield Ave, Berkeley Heights, N J.

• **Photovoltaic readout cell** for computer and control applications, Type HTA-121, has nominal output current of 275



microamps into a 1,000 ohm load when subjected to intensity of 500 foot-candles Spectral response range is 0 4 to 1 15 microns and operating temperature range is —65C to 150C Heliotek, 12500 Gladston Ave, Sylmar, Calif.

FILTER CENTER

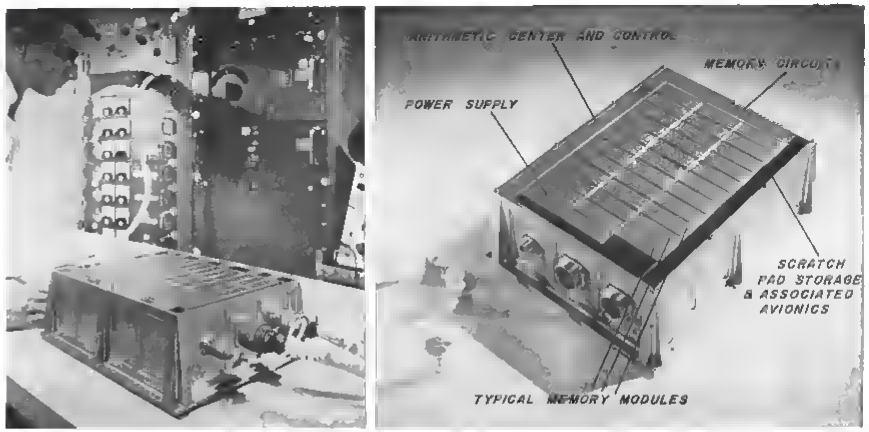
► **Radio Spectrum Use**—New technical note, entitled "Efficient Use of the Radio Spectrum," prepared by National Bureau of Standards presents methods for determining required transmitter power in presence of noise and making efficient use of spectrum in presence of interfering signals The Technical Note 158 is available from Superintendent of Documents United States Government Printing Office, Washington 25, D C for $2 00

► **"Rat's Nest" Measures Laser Power**—New type calorimeter to measure energy level of a laser beam has been developed by Westinghouse Electric's Defense Center, Baltimore The device consists of about 1,000 ft of extremely thin wire which is loosely and randomly packed into a glass container that is silvered on its inner surface to prevent escape of energy When beam strikes the "rat's nest" of thin wire, it heats it almost instantly, changing its resistance which is measured by a galvanometer bridge arrangement The new device will be marketed by Westinghouse Electronic Tube Division, Box 284, Elmira, N Y.

► **Soviet Book Describes Missile Guidance**—English translation of an 831-page Soviet book on guidance and telemetry for ballistic missiles, satellites and aircraft, which is largely based on Soviet appraisal of foreign literature, is now available from Office of Technical Services, Commerce Dept, Washington 25, D C The book, called "Radio Control" (despite references to inertial guidance of missiles), is identified by order number 62 317722 and is priced at $9 00

► **Microcircuit Telemetry Project**—Radiation Inc, Melbourne, Fla, will develop and build a pulse-code modulation telemetry system using thin film and semiconductor microcircuitry under a $400,000 contract awarded by the Air Force Systems Command's Aeronautical Systems Division, Electromagnetic Warfare and Communications Laboratory Prototype is to handle more than 100 channels of information and measure less than 60 cu in in volume

► **Univac Military Marketing Moves**—Sperry Rand's Univac Military Division marketing organization will move to Washington from St Paul, Minn early in November It joins growing list of aerospace and avionics companies which believe that marketing organization location should be near customer rather than the factory



LIBRASCOPE AEROSPACE COMPUTER combines high capacity of unusual type of random access permanent memory and potentially high reliability and compact size of semiconductor microcircuits. Left, technician performs checkout at company's San Marcos, Calif., facility. Right, computer mockup indicates physical layout including modular memory, expandible from its 32 256 word module size.

Space Computer Has High Speed, Capacity

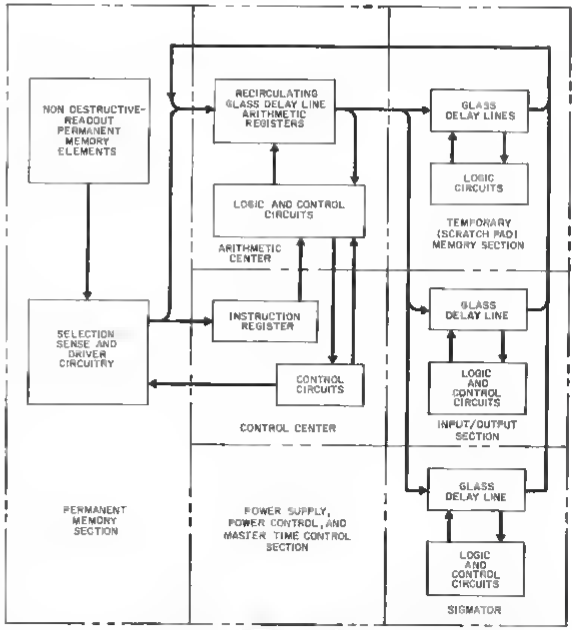
By Barry Miller

Los Angeles—An unusually high speed and high-capacity general purpose digital computer intended for a wide range of possible aerospace applications will be introduced at the American Rocket Society's Annual Meeting and Space Flight Exposition here this week.

Developed by Librascope Division of General Precision, Inc., and now in the prototype stage, the 20 lb computer has a capacity of 8,192 words, each 28 bits long, and a clock rate of 20 mc. This combination of light weight, high capacity and high clock rate are expected to make the machine competitive for guidance, control and data processing functions in the next generation of aerospace vehicles. A version of this computer, which Librascope calls its L-90, was proposed to several bidders in the recent National Aeronautics and Space Administration competition for the Lunar Excursion Module.

The new computer represents the company's assessment of all factors needed in a simple, flexible computer, capable of performing many aerospace functions, according to William E. Bratton, Librascope president.

It has four times the effective memory capacity of the guidance computer for the Centaur booster, which Librascope supplies to General Dynamics/Astronautics, (AW Dec. 26, 1960, p. 65) according to Dr. Donald L. Farr, manager of Librascope's San Marcos branch. The L-90 is about 50 times faster than



BLOCK DIAGRAM of L-90 computer indicates extensive use of glass delay lines to get high bit rates and access times. Computer weighs 20 lb., will occupy about 0.3 cu. ft.

FLYING NOW... WORLD'S FIRST JET FREIGHTER, THE DC-8F

IT HANDLES ALL CARGO Capacity is 95,282 pounds. Big cargo door (85x140 inches) plus integral cargo handling system speeds on and off loading.

OR ALL PASSENGERS 189 passengers can enjoy true DC-8 comfort and performance.

OR ANY CARGO-PASSENGER MIX Bulkheads can be moved and seats rearranged to any of 12 cabin configurations in only 2 hours. Seats not needed are stowed in the hold.

Once again Douglas has been first to cross a new frontier in Aviation. With the maiden flight of its DC-8F "Jet Trader," first all jet aircraft designed for cargo transportation, Douglas has brought new dimensions of speed, capability and economy to air freight.

The DC-8F's performance is equal in all respects to that of the Series 50 DC-8, which has flown higher, faster, and farther than any other jetliner.

It has a productivity potential of 75 million ton miles per year, seven times as great as the C-118A (DC-6A) and thirty-one times that of the C-47 (DC-3F).

As an end result of an extensive Douglas study of military cargo, a complete military loading system is available. This is designed for rugged use with unskilled personnel, and incorporates pallets which will support five tons each.

The DC-8F is crafted with emphasis on famed Douglas reliability, as demonstrated by C-47s, 54s, 118s, 124s, 133s, DC-3s, 4s, 6s, 7s and 8s . . . more than thirteen thousand in all.

Based on the service records of these earlier Douglas transports, predictions are that the DC-8F will still be on the job a quarter of a century from now.

DOUGLAS BUILDS GREAT TRANSPORTS

DOUGLAS AIRCRAFT DIVISION

the Centaur computer and it almost halves the 73-lb weight of the Centaur computer box

The Centaur computer was an adaptation of the AN/ASN-24 developed by Librascope about five years ago under USAF Aeronautical Systems Division sponsorship (AW May 25, 1959, p 124) Other versions of this same basic computer went into other projects and currently are earmarked for the Lockheed C-141

Just as the company developed and produced a basic AN/ASN-24 with a potential to grow and be applied to other systems, so it plans to try to repeat that pattern with the L-90 for airborne and space systems that may be operational a decade from now

The L-90 system is unusual in several respects, including

▪ **Semiconductor microcircuits** — L-90 will employ semiconductor microcircuits for logic and gating functions because of the potentially high reliability of these devices made possible partly by the diminution in the number of hand-made connections among parts and partly because of the inherent potential advantages of semiconductor technology. In all, about 800 of the 1,200 component parts in the machine will be semiconductor microcircuits The remainder will be a mixture of conventional devices and 40 thin film microcircuits. The use of microcircuits reduces the machine's component parts count—an equivalent system, using individual, conventional components

Honeycomb Lens

Antenna lens used in AN/SPG-49 shipboard radar for Talos missile employs molded plastic impregnated glass fiber honeycomb, composed of 4,100 cells which are coated with silver to make it electrically conductive Developed by Sperry Gyroscope, new metalized plastic lens has twice the gain of earlier metal version and weighs considerably less, company says

would require 6,800 components instead of 1,200. Even the 6,800 figure is a low one, a consequence of the type of memory and arithmetic unit designed for the L-90.

Thus, reliability should be improved by the attempt to minimize the number of components and by the introduction of microcircuits.

• **Permanent, random access, modular memory**—A permanent, nondestructive random access memory with a capacity of 8,192 28-bit words is employed in the machine. Clock rate is 20 mc and information rate is 4 mc. The memory is composed of 32 individual plug-in memory modules of 256-word capacity, logically organized into 512 words. Word length can be electrically altered and is programmable.

In the memory, information stored in magnetic areas along wires is interrogated by disturbing the areas by sonic waves passed down the wire. For proprietary reasons, the company is reluctant to describe the memory in detail other than to point out that it is what Librascope believes to be the first practical application of a technique previously reported. A key feature of the memory is the company's claim that it is insensitive to temperature and vibration variations.

Another consequence of this type of memory, according to Parr, is that all of the circuitry associated with selection, retrieval and amplification of information from the memory would take only 750 components if conventional components were used. This number is roughly comparable to that required for a drum.

Infrared Communicator

Infrared communicator for private two-way battlefield communications, provides ranges up to 10 mi. Model 52 shown weighs less than 11 lb and includes built-in speaker which serves as microphone. Four-power telescope is used to align infrared beam with other station and also serves as handle. Manufacturer of the communicator is Raytheon, Santa Barbara, Calif.

The powerful STOL Hercules can operate from short, rough, hacked-out strips anywhere on earth for counter-insurgency airlift operations.

Ten-ton STOL for TAC—now!

There seems to be no limit to the different kinds of work the Lockheed C-130 Hercules can do. Now the famous big bird is an STOL transport, too.

Lockheed-Georgia engineers have come up with design changes that enable the famous workhorse Hercules to achieve STOL performance requirements for the military services.

The STOL Hercules is ready to go into production immediately to give the Tactical Air Command effective airlift for ground troops — to provide STOL performance plus straight-in rear loading at truck-bed height; rough-field landing and takeoff; and ability to air-drop paratroops and large cargoes.

LOCKHEED-GEORGIA COMPANY

Marietta, Georgia • A division of Lockheed Aircraft Corporation

MMRBM Guidance Computer Detailed

Los Angeles—Details of a general purpose digital computer developed as a backup guidance computer for the stellar inertial guidance system of the mobile medium range ballistic missile were revealed here recently by A C Spark Plug Division of General Motors. The computer uses Fairchild Semiconductor microcircuits for all its logic functions as first reported in Aviation Week (Feb. 12, p. 73)

The computer is A C Spark Plug's initial venture in airborne digital computers. It plans to propose this computer or a variation or successor to it in the company's bids for future aerospace guidance business, according to Dr. Robert A. Kudlich, head of AC's computer activities in nearby El Segundo.

AC is a major supplier of ballistic missile guidance systems but in the past it has subcontracted development and fabrication of digital guidance computers. AC supplies inertial guidance systems for the Titan ICBM and recently was selected for a similar role on the Titan 3 space booster. In each case International Business Machines was responsible for the guidance computer.

Last year AC was one of three companies chosen to conduct parallel studies of a stellar inertial guidance system for MMRBM (AW Dec. 25, p. 11). IBM again had responsibility for the computer under an AC subcontract, but the latter went ahead with development of its own microcircuit backup to the IBM computer. General Precision, one of the parallel contractors, later was picked to continue MMRBM guidance system development for which American Bosch will supply the computer.

AC continued its computer effort and has had a prototype computer running programs for the past three months.

General characteristics of the AC computer include:

- Random access erasable non volatile ferrite core memory with a capacity of 4,096 words, 24 bits in length. It has a memory cycle time of 4 microseconds (¼ mc.) Word time is 48 microseconds. It is serial in organization.
- Production computer is expected to weigh about 35 lb., occupy a volume of 0.64 cu. ft. and consume about 90 watts (66 watts for the microcircuits and 24 for the core memory). Size and weight of the prototype are slightly greater.
- Additions can be performed at the rate of 7,000 per second and multiplications at the rate of 2,500 operations per second.
- Logic functions of the machine are performed by 2,100 semiconductor microcircuits (one microsecond logic), comparable to logic assemblies with a total of 20,000 components. The elements including flip flop, nor gate and half adder are part of the commercial microcircuit line of Fairchild Semiconductor.

As in the Librascope computer (see accompanying story) significant benefits in improved reliability are expected from the use of semiconductor microcircuits. AC estimates that the number of hand-made connections and individually fabricated components are cut by an order of magnitude in its machine. It uses about 7,000 component parts not including ferrite storage and switch cores.

During 400 hr. of operating time logged on the prototype computer, there has not been a single spontaneous component failure of any kind, according to company engineers.

memory but less than other solid state memories for airborne use.

- Modular construction—Modular construction of the memory and input and output devices permits an expansion or a reduction of the machine to meet large or minimal requirements.

The computer has 105 microsecond multiply and 203 microsecond divide time and can add or subtract at the rate of 71,000 operations per second (add time is 7 microseconds). These figures include input and output buffering but not conversion. It is designed for operation over a temperature range from −55C to +125C and can handle either synchronous or asynchronous operations.

In developing the computer, a three phase timetable was followed. Part says. This included:

- Phase 1—In this phase high-frequency operation and the logic concepts were verified and a laboratory breadboard model operating at 16 mc. clock rate was fabricated. Completed last spring, this model used commercial circuits.
- Phase 2—Prototype machine for laboratory evaluation, using a combination of semiconductor microcircuits and multi-chip devices, was built and currently is being checked out. Original intention was to utilize multi-chip devices—about five semiconductor chips mounted on a single multilead header—in this phase, but when the vendor failed to deliver components on schedule, Librascope substituted semiconductor microcircuits for the logical gating networks. These were connected with companion components in small welded modules which were mounted as they will be in the final configuration, on the inside walls of the con-

puter case. The modules are interconnected by a welded wire matrix. Basic clock rate for this machine is 20 mc.

• Phase 3—A final flyable computer, using semiconductor microcircuits will be fabricated and is expected to be ready for flight tests with an inertial platform, made by Kearfott, a sister division of Librascope, next fall. The basic computer design work is completed and a prospective microcircuit supplier was selected recently after a vendor evaluation.

Arithmetic Center

Arithmetic center and arithmetic control for the computer uses a single glass delay line in a recirculating mode, plus associated elements. By interleaving bits, five individual arithmetic and control registers are contained on the single delay line, which provides for short access times and high bit rates. This register interlace pattern divides the 20 mc. clock rate by the number of registers, giving a 4 mc. bit rate for each register.

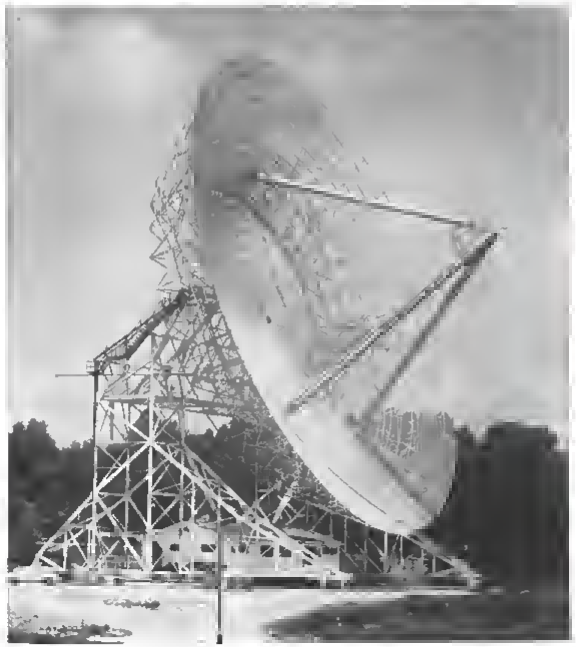
The computer operates in a serial (serial) single address mode, that is, it is serial by word and serial by bit.

Temporary Memory

Its temporary, or scratch pad, memory and an input/output data storage section with a capacity of 260 28-bit words on eight glass delay lines is expandable to double normal capacity by the addition of modules.

Also included in the computer is an auxiliary computing unit, called a sigmator, that can perform basic extrapolations. For example, it would be able to sum pulses from an accelerometer. If it were receiving velocity information, it could integrate this once to determine position. A glass delay line in the sigmator can accept asynchronous pulse data and integrate these at rate of 11,000 iterations per second.

Librascope plans to package the en-



Navy Radar to Track Canaveral, Wallops Launches

New Navy radar for research on missile and space target detection, recently completed at Naval Research Laboratory's Chesapeake Bay Annex near Washington, will be used to track missiles launched 640 mi. away at Cape Canaveral and rockets launched from nearby Wallops Island facility of NASA. Radar initially will operate at frequency of 138.6 and 435 mc. but is designed to permit operation at 1,400 mc. The 150-ft.-dia. paraboloidal reflector shown has 90 deg. of elevation motion and 360 deg. in azimuth.

NASA'S "MOON BUG"

4-DAY HOME FOR FIRST LUNAR EXPLORERS

The 'moon bug,' more formally known as the Lunar Excursion Vehicle, will ferry the first two of NASA's lunar visitors from an orbiting Apollo spacecraft to the moon's surface.

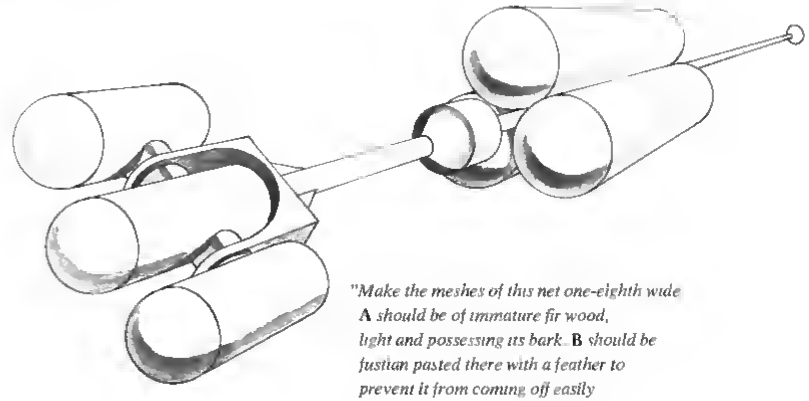
For as long as four days, the two astronauts will explore the moon—one of man's most incredible scientific opportunities—using the 'moon bug' as home base. Then they will rendezvous with the mother ship, in which a third astronaut will have been circling the moon. They will re-enter the Apollo command module, jettison the 'moon bug' and head for Earth.

It will happen before this decade is over.

This venture and NASA's many other advanced projects require scientists and engineers with the highest qualifications. If you are interested in employment with NASA, please send a resume to Personnel Officer, Dept. NA-5, of: NASA Headquarters (BPH), Washington 25, D. C.; NASA Goddard Space Flight Center, Greenbelt, Md.; NASA Langley Research Center, Hampton, Va.; NASA Lewis Research Center, Cleveland, Ohio; NASA Marshall Space Flight Center, Huntsville, Ala.; NASA Ames Research Center, Mountain View, Calif.; NASA Flight Research Center, Edwards, Calif.; NASA Manned Space Craft Center, Houston, Texas; NASA Launch Operations Center, Cocoa Beach, Florida.

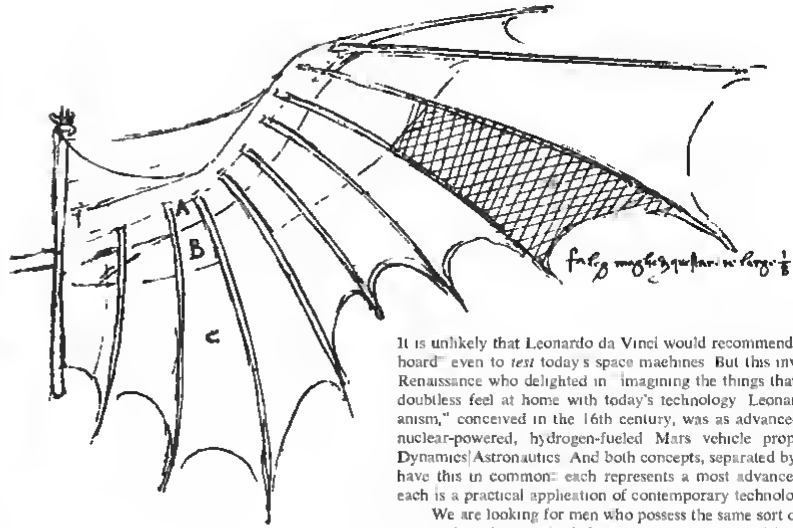
NASA

NASA IS AN EQUAL OPPORTUNITY EMPLOYER (U. S. CITIZENSHIP ESSENTIAL)



"Make the meshes of this net one-eighth wide.
A should be of immature fir wood,
light and possessing its bark. B should be
fustian pasted there with a feather to
prevent it from coming off easily.
C should be starched taffeta . . .

and as a test, use thin pasteboard."



It is unlikely that Leonardo da Vinci would recommend using "thin pasteboard" even to *test* today's space machines. But this inventor-artist of the Renaissance who delighted in "imagining the things that are to be" would doubtless feel at home with today's technology. Leonardo's "wing mechanism," conceived in the 16th century, was as advanced in its day as the nuclear-powered, hydrogen-fueled Mars vehicle proposed by General Dynamics|Astronautics. And both concepts, separated by centuries of time, have this in common: each represents a most advanced state of the art, each is a practical application of contemporary technology.

We are looking for men who possess the same sort of unbridled imagination that characterized da Vinci and the men of inventive vision who followed him. The kind of men, in fact, now at Astronautics designing the space systems of the future—an imminent future measured not by centuries but by days and weeks.

If you are challenged by "imagining the things that are to be," learn more about General Dynamics|Astronautics and its role in space.

Use the convenient inquiry form attached or write to Mr. R. M. Smith, Chief of Professional Placement and Personnel, Department 130-90, General Dynamics|Astronautics, 5775 Kearny Villa Road, San Diego 12, California.

GD

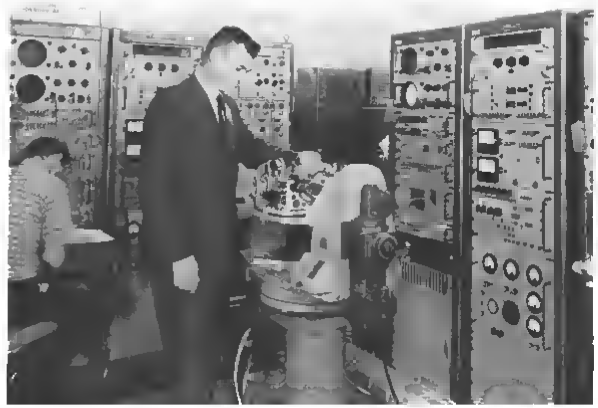
GENERAL DYNAMICS | ASTRONAUTICS

the computer into a 4½ in. x 13 in. x 14 in. gold plated magnesium case (including flanges), the sides of which are removable. The case occupies about 0.3 cu. ft. and memory modules account for roughly half of the 20 lb. over-all weight.

The memory modules, which dissipate a negligible amount of power (about 5 of 30 watts for entire system) plug into a wired interconnection matrix on the base of the case. The heat generation elements of the computer are mounted along the inner walls of the case surrounding the memory. Individual components and microcircuits, which will probably be packaged on multi-lead transistor headers, are in turn packed into small cube-like welded modules which are interconnected by welded wire matrices on the computer walls.

As indicated in an accompanying photograph, the scratch pad memory and associated avionics are attached to one wall, the arithmetic center and control center on another, the memory circuits along the back wall. In the middle are the memory modules.

Field maintenance would be performed on the "wall" level by replacing the entire wall of the computer if a fault is located and returning the wall to a checkout center where the faulty module could be replaced.



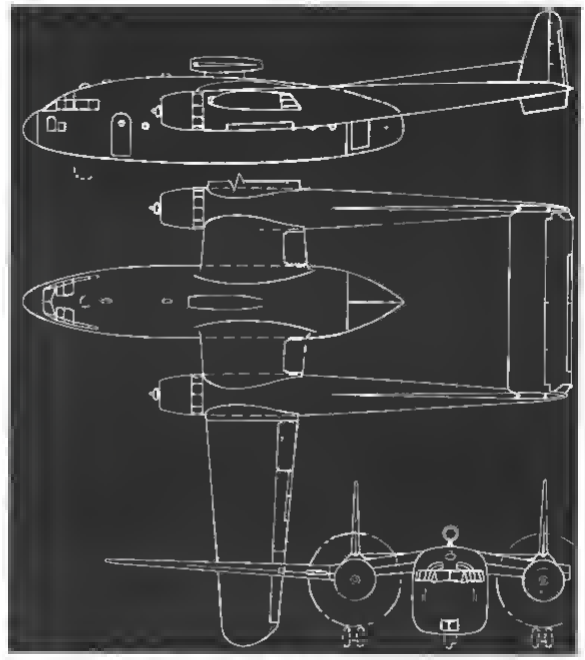
Inertial Navigation System to Be Tested in DC-8

Litton stabilized platform is heart of 80 lb. LN-3 inertial navigation system which will be modified for airline evaluation tests by Pan American in a DC-8, under Federal Aviation Agency sponsorship. Litton is major supplier of military aircraft inertial systems.

An entire range of aerospace applications, including space and missile boosters, manned and unmanned space vehicles, aircraft and ballistic missiles, are being suggested by Librascope for the L-90. One of the more intriguing ideas, however, involves the usurpation by the computer of functions which are normally reserved to other elements of a system.

Indians Supplied by Jet-Augmented C-119s

By David H. Hoffman



THREE-VIEW shows C-119 with Steward-Davis J34 JetPak attached

JET THRUST augmentation unit for C-119 is shown on a test stand.

Washington—Indian troops fighting in the Himalayan highlands are being supplied by Fairchild C-119 transports with jet thrust augmentation—the only aircraft in India's air force that can climb over mountains to areas invaded by Chinese Communists to airdrop heavy cargo (AW Nov. 5, p. 26).

India has a total of 53 C-119s, but only 27 are being retrofitted with Westinghouse J34 turbojets and six of these are now in service. Since fighting broke out along India's northeast frontier on Sept. 8, this small fleet has been shuttling vital equipment between lowland depots and Indian army outposts in the mountains. Aircraft are operating routinely from a 4,000 ft. dirt strip 3,500 ft. above mean sea level with the aid of jet power.

Standard C-119s in the U. S. Air Force Reserve inventory are powered either by two Pratt & Whitney R4360 Turbo Compound engines or by two Wright R3350s. Each piston power plant develops 3,500 hp. But pilots have consistently complained that the C-119 is a marginal performer on single engine, especially when altitude must be preserved to avoid high terrain.

To remedy this problem, and to give the aircraft extra altitude capability, India contracted with Steward-Davis, Inc., of Long Beach, Calif., for jet thrust augmentation (AW Nov. 5, p. 26).

A single J34 mounted on top of the C-119's center wing section gives the Indian aircraft 3,400 lb. of added thrust. According to Steward-Davis, total retail cost of this installation is $59,000, but discounts are offered customers who order in quantity.

Here are some specific performance comparisons between the unmodified C-119 and the aircraft equipped with the Steward-Davis "JetPak."

- **Standard C-119,** during tests in India, took off at 70,000 lb. gross weight and climbed to 23,000 ft. in 36 min. C-119 with thrust augmentation took off at the same weight and, using identical piston power settings, reached 23,000 ft. in 17 min. Although its J34 was kept running throughout this climbout, the jet-equipped C-119 consumed 250 gal. less gasoline than the standard aircraft because of its shorter time to climb, according to Steward-Davis.
- **Single engine performance** of the C-119 with thrust augmentation far exceeds that of the unmodified aircraft. At a gross weight of 77,000 lb. with one piston engine feathered, the jet-

Netherlands Navy Gets Bell 204B

Royal Netherlands Navy has ordered eight Agusta Bell 204B helicopters, powered by Bristol Siddeley Gnome H.1000 turbine engines, each with a 1 hr rating of 1,050 shp. Gnome was developed by de Havilland Engines Ltd., but company has since been bought by Bristol Siddeley and absorbed into the group. Engine is in quantity production for 204B helicopters.

equipped C-119 matches the single engine performance of a standard aircraft weighing only 53,000 lb., Steward Davis says. In addition, a standard C-119 weighing 60,000 lb. is unable to maintain altitude on single engine with METO (maximum except takeoff) power when flying in relatively warm air. With a JetPak, the same aircraft can climb at 420 fpm. on one piston engine.

Main thrust of the Chinese offensive against India has come through the Himalayas east of semi-autonomous Bhutan state. About 150 mi. to the south the Brahmaputra River parallels the combat zone on an east-west course along its broad valley are about 10 abandoned airstrips, built by the U. S. and the United Kingdom during World War 2 to anchor the airlift over the Himalayan "hump" into China.

From some of these airports C-119s are hauling supplies to army units in the highlands to the north. On the Ladakh front, near India's northernmost tip, C-119s are staging from the air base at Srinagar where supplies are being collected for the Army. The border buffer states of Bhutan and Nepal lie between the two combat zones.

Clam-Shell Doors

Aft end of the C-119's cargo compartment is enclosed by clam-shell doors, which are removed on the ground for heavy equipment drops. But removal of these doors has a decidedly adverse effect on C-119 performance. USAF Reserve aircraft, for example, are allowed to take off at a maximum weight of 68,000 lb. with their clam shell doors on, and at only 58,000 lb. with these doors off.

With doors discarded for airdrops, Indian jet-equipped C-119s are leaving the runway at 70,000 lb., by contrast. In all configurations, addition of the JetPak cuts takeoff roll by at least 16%.

In July, 1961, Steward-Davis signed a preliminary contract with the Indian government to retrofit one C-119 with a J34. This was delivered on Oct. 10, and on the basis of operational tests, a second contract was signed last February under which Steward-Davis agreed to supply JetPaks for an additional 26 aircraft. Actual installation of the J34 has been accomplished in India under Steward-Davis supervision.

Over-all modification entails about 300 man hours and can be completed by five experienced mechanics in eight working days. Steward-Davis now is delivering JetPak kits to India at the rate of five per month and predicts that by the end of this year, it will have fulfilled the current contract.

Not until next February will all 27 be available for service against the Chinese, under the present schedule.

Meanwhile, Steward-Davis is negotiating to modify the remaining 26 C-119s in the Indian fleet, a job it says could be finished by March. It is also proposing an assault version of the C-119, which would have the centrally mounted J34 plus two other J34s slung on under-wing pylons.

To gain greater STOL performance which standard C-119s lack, this follow-on version of the aircraft would incorporate a drag parachute braking system. Ailerons and flaps would be given a full-span droop of several degrees to increase available lift. Tip tanks would be added to retain range despite the extra engines. Landing gear and portions of the empennage would be strengthened structurally to permit carriage of greater payloads. The large wheel wells in the C-119 nacelles would be covered by doors to decrease drag on takeoff. Aerodynamic cleanup would be undertaken to rid aircraft of parasite drag wherever practicable.

Such a transport, Steward-Davis believes, would have excellent short field performance. On days with the temperature 30C above standard, the as

Work Stand

Portable aluminum work stand consisting of four corner towers, bridged by long span planks is shown straddling the rudder and stabilizer assembly of a United Air Lines Boeing 720 at its San Francisco maintenance base. The towers, manufactured by Up-Right Scaffolds, Berkeley, Calif., are an assembly of 1-piece folding sections placed one on top of the other to 37 ft. height.

sault C-119 could still operate from 1,000 ft strips at weights as high as 60,000 lb.

If a 1,500 ft strip were available, such a C-119 could use it at a gross weight of 80,000 lb., Steward-Davis says.

According to the company, the 26 unmodified C-119s in India's air force could be re-worked as assault transports for less than $5 million. Cost of a single retrofit would approximate $165,000. By May it estimates, 10 to 20 aircraft could be modified, assuming a prompt order.

C-119 Underpowered

Herbert Steward, president of Steward-Davis, believes that the C-119 is an efficient, simple to fly, easy to maintain aircraft designed for a specialized role in combat. As such, he told AVIATION WEEK, it lacks real competition. The C-119's major flaw—and on this point most C-119 pilots are agreed—is that the aircraft is underpowered. Steward feels addition to the JetPak corrects this deficiency.

Westinghouse discontinued J34 production several years ago. In the interim, Steward-Davis purchased all manufacturing rights on the engine. It also bought the type certificate and manufacturing rights for the Fairchild C-82, forerunner of the C-119, and has equipped several with JetPaks for commercial customers. A program aimed at obtaining Federal Aviation Agency certification of the augmented C-82 as a domestic airfreighter now is under way.

To mount a J34 atop the C-119, Steward-Davis first removes a section of the skin on its center wing panel. An adapter then is fastened to the front wing spar.

Three bolts link the J34's small, vertical pylon to the adapter plate. Installation of the adapter is the one structural modification required for the retrofit.

Only the J34's nacelle and pylon protrude above the C-119's wing; other accessories are housed inside the fuselage on a small deck located aft and above the cockpit of all standard 119s. A ladder leading upward from the floor of the C-119's cargo compartment makes this deck accessible to crewmembers in flight.

The J34's accessory gear box, oil pump, fuel control unit, etc., are linked to the turbojet proper by an extension shaft with flexible couplings. Shaft extracts power from the jet's front compressor section and supplies it to the accessories below.

In the event of electrical failure, all valves in the installation can be opened and closed manually. The J34's nacelle door and starter actuator valves, moreover, are identical to the C-119 main landing gear actuator valve, thus sparing operators the need to stock spares separately.

Total weight of the JetPak installation is 1,407 lb.

Both the Lockheed P2V patrol aircraft and the Boeing KB-50J tanker are equipped with thrust augmentation jets.

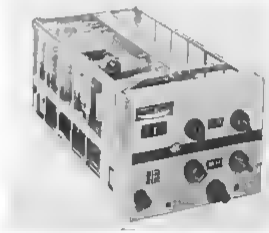
Fuel for the J34 is standard 115-145 octane aviation gas taken from the C-119's tanks; there is no separate fuel system.

Average sea level consumption at maximum thrust is about 600 gph. At 10,000 ft. at METO power, consumption is about 400 gph.

In a typical operation, the J34 is ignited as the C-119 takes the active runway for takeoff. No pre-flight run-up check is required. The jet is run for about one minute during climb, then shut down and not reignited until the aircraft has entered the landing pattern at its destination airport.

Should an emergency crop up in flight, the J34 can be started almost instantaneously with the hydraulic starter.

However, windmill starts are possible above 130 kt. indicated air speed, and involve only opening the nacelle doors with an electric toggle switch in the cockpit, opening the auxiliary fuel shutoff valve (also with a toggle switch), waiting for light-off rpm. (about 10-12%), and cracking the J34 throttle.



Com/Nav System

Combination navigation/communication system includes 7-watt transmitter-crystal controlled receiver providing 90 channels with 100 kc spacing plus VOR localizer reception from 108 to 118 mc in 100 kc steps. Total system weight is 13.8 lb including accessory converter. New system is one item in three new product lines of avionics equipment announced by Aircraft Radio Corp. Top line of avionics meets TSO Category A, middle line meets TSO Category B while third line is budget priced for light aircraft. Included are three new autopilots ranging in price from $950 to $1,995 plus installation.

PRODUCTION BRIEFING

Continental Aviation and Engineering Corp. has been awarded an Air Force contract to investigate and demonstrate new design concepts which can be used in developing a lightweight jet engine for use in VTOL aircraft. Objective will be to develop designs with both commercial and military applications.

United States Rubber Co. will develop new materials and techniques for construction of inflatable space stations under a contract from the National Aeronautics and Space Administration. Company has proposed a filament wound skin possibly of glass fiber. Skin would be wound over a frame and then collapsed for packaging after the frame is removed.

Computer Engineering Associates, Pasadena, Calif., has been selected by North American Aviation, Inc.'s Space and Information Systems Division to study and analyze the dynamic response characteristics of the Saturn S-2 structure during captive firings. Purpose of the study is to predict dynamic load paths for use in structure weight designs.

American Machine & Foundry Co. has been awarded a $5-million Air Force contract for the re-installation and checkout of the Titan ICBM launcher at Complex 4C-1, Beale AFB, Calif. The complex was destroyed by an explosion and fire May 24 (AW May 28, p. 37).

Dalmo Victor, a division of Textron Inc., Belmont, Calif., will produce airborne magnetic detecting equipment for use in anti-submarine aircraft under a $540,000 follow-on contract from Navy's Bureau of Weapons.

Fiat Aero Engine plant Torino, Italy, has started production of the J79-11A jet engine under license from General Electric. Engine will be used in the F-104G being built by Fiat and SABCA of Belgium for use by NATO forces.

Vitro Corp. of America has received three Navy contracts, totaling $2.8 million for engineering work on ships which are to be equipped with the Terrier, Tartar and Talos missile systems.

Garrett-AiResearch will produce 190 temperature control air conditioning and pressurization systems for the CL-41A jet trainer. Work is financed by a $1-million contract from Canadair, Ltd., Montreal.

Leach Corp. has received a $1-million contract from Lockheed Missiles and Space Co. for development of satellite tape recorders capable of withstanding high nuclear radiation levels. Life cycle of more than 1,000 hr. continuous service is being sought.

Radio Corp. of America has been awarded a $225,000 contract by the Boeing Co. for production of spares for the Minuteman ICBM test equipment. Pyle-National Co. also has been awarded a Minuteman contract, totaling $550,000, for production of parts for the data transmission network used in the missile system launch installations.

Republic Aviation Corp. will design and fabricate plastic rudders for Navy's experimental Dolphin deep-diving submarine. Rudders are based on a new concept in lightweight construction.

Swedlow, Inc., of Los Angeles, has received a $200,000 contract from Republic Aviation Corp. for production of 36 sets of cockpit canopy panels for Republic's two-place F-105F jet.

Westinghouse Electric Corp.'s Air Arm Division is conducting studies in manual control of space vehicles during simulated orbital rendezvous, using an analog computer, simulated spacecraft and actual controls. Objective of the company-sponsored experiments will be to determine the best configuration for rendezvous display systems of the type Westinghouse will build for Project Gemini.

Marquart Corp.'s Ogden, Utah, plant will manufacture nozzles for first stage of Navy's Polaris missiles under a $1-million contract from Aerojet-General Corp.

Northrop Corp.'s Astronertial guidance system, designed for Air Force's Douglas Skybolt missile, has undergone initial sled tests proving its mechanical and electrical integrity and its basic inertial platform stability. Tests are being conducted at Holloman AFB, N.M.

Cessna Aircraft Co. has received a $6,404,376 contract from McDonnell Aircraft Corp. for production of bomb rack assemblies, missile ejection rack assemblies and missile and wing tank pylons for Navy's F4H and Air Force's F-110.

Avco Corp.'s Lycoming Division has been selected to produce the electrical power system for the Vought-Hiller-Ryan XC-142 tri-service V/STOL assault transport. System used will be Lycoming's 42-hp. LD3-7 constant speed drive.

National Cash Register Co. will study techniques of encapsulating chemicals which, when mixed together, will react and expand 30 times to form rigid foam structures. Program, financed by $49,078 Air Force research contract, is aimed at determining feasibility of making self-erecting foam shelters for use by future space explorers.

Bendix Corp.'s Pacific Division has been awarded a study contract to determine feasibility of the guidance unit for Army's new Derringer missile weapon system.

Soviets Display Guideline Missile

Cuban surface-to-air missile sites are equipped with a version of the Soviet Guideline missile, which is shown here during a May Day parade in Moscow. Guideline booster has a large set of cruciform stabilizing control fins. Second stage has a small set of wedge shape control fins aft and two more sets of cruciform fins forward.

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CARGO AIRCRAFT
make safe letdowns through cloud cover at non instrumented fields, avoid obstacles when off course

DRONES
escape early detection by flying ground-hugging courses to targets on automatic guidance systems.

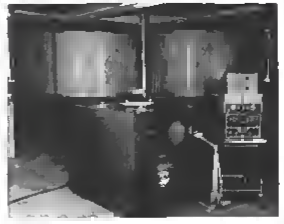
NEW 40-LB. TERRAIN AVOIDANCE RADAR BROADENS MISSION CAPABILITIES FOR AIRCRAFT AND DRONES

Improved safety and new mission capabilities can be added to virtually any aircraft with the new, flight-tested* terrain-following radar developed by General Dynamics|Electronics. Regardless of visibility, aircraft and drones using the compact system can fly ground-hugging penetration missions below enemy radar. Flying manually or automatically at altitudes under 400 feet, equipped aircraft escape detection while the terrain-following radar detects unseen obstacles ahead. The low-cost system also enables pilots to letdown safely through cloud-cover to non-instrumented airports and protects aircraft that drift off course when over unknown terrain at night or during inclement weather. The General Dynamics|Electronics equipment requires a minimum of maintenance since the non-scanning antenna approach uses no moving parts. No radar-scope is required either. Instead, a simple indicator provides continuous flight instructions. For information about Terrain Avoidance Radar write Department C-91, General Dynamics|Electronics-San Diego, P O. Box 127, San Diego 12, California.

**The system has been flight tested more than 15 000 miles at altitudes under 400 ft*

GENERAL DYNAMICS | ELECTRONICS GD SAN DIEGO

NEW AEROSPACE PRODUCTS



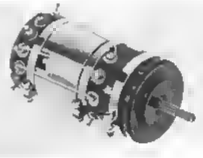
Balancing Machine

Semi-portable vertical dynamic balancing machine and computing system detects, analyzes and translates vibration into corrective balancing data.

Device is designed to balance components having only one positive mounting point by rotating them at speeds up to 300 rpm. Test pieces up to 300 lb and 36 in. long can be handled.

Displacement due to unbalance is detected and fed into a computer, which separates and cancels the effect of motion in each plane and determines displacement values. Machine has an automatic shut-off control.

International Research and Development Corp., 6150 Huntley Rd., Worthington, Ohio.



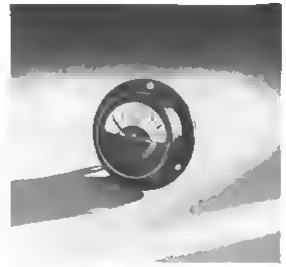
Multi-turn Potentiometer

Precision potentiometer, designed for servo mounting, makes specialized continuous rotation control functions possible by performing three operations usually accomplished with separate externally coupled components, according to the manufacturer.

Unit, defined as a fine rather than a coarse control device, is designed for speeds up to 20 rpm with a component life of 500,000 revolutions. It consists of a three-pole switch commutator and a 20:1 servo gearhead, all axially assembled and operated by a single input shaft.

Design eliminates extra cams, electrical relays and accessory power, resulting in lower cost, smaller size and higher reliability, manufacturer says.

Technology Instruments Corp. of California, 850 Lawrence Drive, Newbury Park, Calif.



Miniature Meter

One-inch panel meter, designed for good readability, minimizes parallax and reduces possibility of reading error by setting scale and pointer close to the curved glass crystal, according to the manufacturer.

Meter is available as microammeter, milliammeter and a.c. or d.c. voltmeter. Two-ounce meter is adaptable to edge-lit panels on stationary, portable or airborne equipment where weight and size are significant.

International Instruments, Inc., 88 Marsh Hill Rd., Orange, Conn.

Electrical Connector

Electrical connector, hermetically sealed in an aluminum shell with a silico-ceramic insulation, is designed to operate in a temperature range of —385F to 700F, the manufacturer says.

In addition, the connector has a life span of 10,000 hr. at 650F and will resist cryogenic and nuclear environments, according to the manufacturer. Connector is available in TI, PS, HP and BL series configurations.

Connector weighs 5.5 grams.

Physical Sciences Corp., 389 North Fair Oaks Ave., Pasadena, Calif.

Light Aircraft Turbocharger

Lightweight turbocharger for light aircraft engines can be adapted to engines in the 240 cu. in. to 470 cu. in. class, the manufacturer says. The unit, designated TEO6, is designed to utilize V-band clamps on turbine inlet and exhaust flanges for aircraft mounting requirements.

Garret Corp.'s AiResearch Industrial Division, 9225 Aviation Blvd., Los Angeles, Calif.

YOUR WORLD OF

OPPORTUNITY

MANAGEMENT

Chamber of Commerce Urges Space Committee

New York—Establishment of an advisory commission to examine and recommend national space goals and how they should be achieved over the next 10 to 20 years was urged recently by U.S. Chamber of Commerce President Ladd Plumley.

At a meeting of the Harvard Business School Club of New York, Plumley cited what he called "urgent desperate" questions about the impact of space program planning on the United States.

He said these are among most pressing problems the commission could study:

- **Government monopoly** in research and development reflected not only in the $12.5 billion the government will spend in Fiscal 1963 for research, but also "in the brainpower being siphoned into federal service to manage and perform this work."
- **Damage compensation** legislation, to establish liability for accidents which result from space activities.
- **Patent policy** for National Aeronautics and Space Administration. Plumley noted that Congress has adjourned without taking action on such a policy.
- **Government consultation** with leaders of communities impacted by NASA programs. Plumley said community service plans are necessary not only for those cities where programs are placed but also for contiguous and distant communities which have not yet been surveyed. Problems faced by these cities he said, involve draining the labor supply, dislocation of schools and new requirements for hospitals and utilities.
- **Space program cost.** Plumley was careful not to criticize the amount U.S. is spending in space, but he said "the Russians already are finding it impossible to grow enough food to feed their people, largely because of the national effort the Kremlin is diverting into space."

He said the U.S. could "throw the equivalent of Russia's whole national income into our space effort and still manage to keep a relatively high standard of living." He said, however, U.S. expenditures in space are not pleasant to contemplate and national priorities must be established for space programs.

Plumley said the commission members should be non-political. Membership, he said, should consist of scientists, economists, military, businessmen, educators, labor spokesmen, and congressional leaders.

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(Continued from p. 156)

News Control Sets Dangerous Pattern

Tulsa Daily World—Nov. 2

The Department of Defense has made a dangerous mistake in its new policy of air tight control on information given to news media.

The department is now requiring that any time one of its military or civilian officials speaks to a newsman—in person or by telephone—he must report it to a public information officer by the end of the day.

The effect of such an order can only be to close up the flow of information except what is permitted through official channels. It goes directly against the historic American concept of freedom of information—and should be struck down immediately.

We do not argue that everything is the public's business in the Defense Department. Certainly there are matters that must be kept classified in the best interests of the nation. This has been the practice in the past and will continue. Any responsible newsman will agree that some security information must be kept secret.

But this new policy does not affect classification. It means, simply, that the department is clamping a tight gag around every person under its control, to prevent any information from being given out that might be displeasing to somebody at the top.

Arthur Sylvester, the spokesman who handed out the order, says it is not intended to inhibit Pentagon personnel from talking to newsmen. But it is bound to have that effect. What military man or civilian employe of the department is going to take a chance on being blamed for letting the press have facts that might not be on the approved list in the secretary's office?

This policy is all the more dangerous in the light of the recent deception practiced by the Pentagon and the White House when President Kennedy was called off his campaign tour because of a "cold"—according to the official announcement.

Actually the President was going back to Washington to take up the Cuban situation. Sylvester acknowledges that such false official reports are part of the "arsenal" at the government's disposal and says he believes the results justify the methods.

This nation has always proceeded on the basis that the people are entitled to the truth. It has been embarrassing at times but it has always been found best in the long run—and the people could at least have some confidence in their news reports.

If a new policy of distorting and choking off the news is to be followed in the Defense Department are we not taking a fateful step towards total censorship?

New Censor Rules Recall Goebbels

By Mark S. Watson—Baltimore Sun

Washington, Nov. 1—In formulating its new and unprecedented regulations of news censorship the Administration has thrown overboard the wartime principles and practices which two world wars have justified.

The "see nothing, hear nothing, say nothing" rules discouraging natural news practices which have just been imposed on the military professionals have already resulted in inaccurate public statements by civilian spokesmen whose basic knowledge of military matters is scant. The rules silence military professionals whose judgment of "dangerous" news is infinitely better.

But Tuesday's official dictum that "government-generated news" is a "weapon" officially regarded as a desirable substitute for normal news is far more disturbing. It suggests the policy and the performance of Adolf Hitler's propaganda chief Paul Joseph Goebbels who prescribed what Germans should be allowed to read and think.

A surprising aspect of the "say nothing" edict is that it runs counter to national experience in far greater military emergencies. During World War 2, as at other times, there was a voluntary self censoring by press and radio, in pursuit of a code which stated simply and clearly what kind of news publication was against the national interest.

A group of military and journalistic experts was on duty to explain the code's applications to events. Faulty judgments by press and radio were so rare that they are hard to remember, due in large measure to the fact that experienced officers of the armed services were encouraged to provide professional guidance on the significance of news events.

Up to now the Cuban affair has not gone far enough to produce momentous misfortunes, but it has already produced from a civilian who is presented as spokesman some statements which are notoriously inaccurate. This was not by his design, certainly, but due solely to ignorance resulting from lack of experience.

An example is useful. On one occasion a specific act which the official spokesman confidently stated had taken place, actually would have constituted an act of war. The fact is that this act did not take place. The spokesman, quite unintentionally, had made a misstatement.

That is bad enough. What is worse is that the spokesman did not even know the gravity of his error. An experienced naval officer would have known it and could not have made such a blunder. This sort of bumbling is dangerous.

The faults of the present "government-generated news," therefore, are twofold. Through concentrating on reports from civilians instead of supplying military guidance such as always was available before at such briefings, there are actual misstatements.

And through a comic horror of allowing publication of routine facts wholly known to a potential enemy, this sort of information is kept from nobody except the American public.

A petty example is the pains which the Administration spokesmen still take to prevent reporting even approximately how many United States Marines are at the naval base in Guantanamo. Into that base every day pour 2,500 Cuban civilian workers. Out they all go at evening to make what ever report they feel like making to any Cuban authority questioning them.

To think that the Castro government does not have its information whenever a new ship unloads is to be impervious to horse sense as some of the Pentagon's top civilians have become.

Pentagon Censorship

Dallas Morning News—Nov. 2

It is revealed that the Pentagon has been "managing" the news during the Cuban crisis. Any government or branch of government that imposes a censorship on information about its policies usually does so for one reason and one reason only—it does not want the public to know about the errors it might make.

Further it wants to give the people propaganda about its own merits through the news it "manages."

Imposition of a censorship usually comes in the class of those things that "creep" into use. At first only a small advance is made. There are evasion and duplicity in answering the questions of the press. Next there is an outright refusal to give the people the news. Finally, the government takes the offensive and tells the press what to say.

It can become a part of the path to dictatorship.

We have seen excellent examples in Italy, Germany and the Soviet Union.

Any official withholding of news from the public is an outright denial of the theory of democracy. The people cannot rule unless they have the facts upon which to base their judgments.

We have seen the tendency toward censorship in other places than the Pentagon during this Cuban crisis. For example, the President's press secretary was asked if air reconnaissance over Cuba would be resumed if Castro continued in his defiant attitude. He could have said yes or no. Instead, he said "in the absence of United Nations' arrangements the hemisphere nations have the responsibility for continuing surveillance." This was a clear evasion of the question.

Acting Secretary General U Thant of the United Nations, in answer to direct questions about the success of his mission aimed largely at getting Castro's agreement to inspection of missile bases, would not answer directly, but said only that his mission had had "fruitful results."

This was a distorted answer. U Thant also deals in bad faith with the nation which is his principal financial supporter—the nation that has recently "lent" the UN $100,000,000 to pay the debts that Castro's friend Russia refuses to pay.

Arthur Sylvester, assistant secretary of defense for public affairs, justifies the action of the Pentagon by saying that "The generation of news by action taken by the government becomes one weapon in a strained situation" enabling the government of the United States to speak "in one voice" to the adversary.

This sort of news "management" is a leading characteristic of paternalistic governments throughout the world. We cannot oppose communism or other unAmerican isms by resorting to our own adaptations of their techniques.

The American news media cooperated magnificently with the government during World War 2 in a voluntary censorship system that protected our security. Veterans in the Pentagon know that. The present system is indirect admission that our government does not have faith in the press, radio and television.

Mutual faith on the part of all is necessary in any crisis.

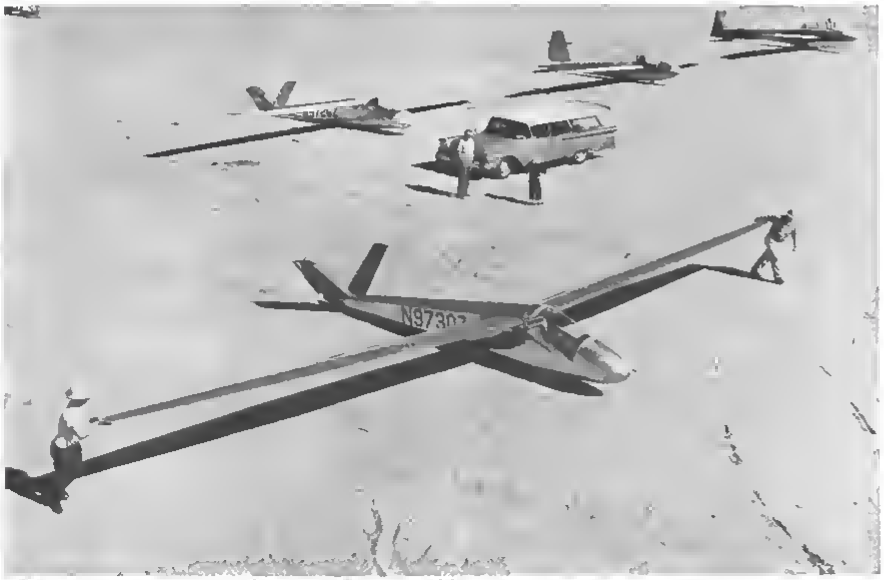
Prue Standard is an all aluminum sailplane with an empty weight of 425 lb. and a maximum glide ratio of 33-to-1 at 52 mph.

Briegleb BG 12 is one of few U. S. sailplanes designed to sell in quantity. Note large, highly deflected flaps.

New American Sailplane Models Show Variety of Design Approaches

Home-built, high performance sailplanes of American design appeared in increasing numbers at the National Soaring Championships in El Mirage, Calif. In recent years, production designs of British and German make had dominated the event. Championship was won by Sisu 1 flown by John D. Ryan, below. Aircraft is being marketed by Arlington Aircraft Co., Arlington, Tex. The sailplane is all-metal with wings that are swept forward 2.92 deg. and have an aspect ratio of 23:1. Maximum glide ratio is claimed in excess of 40-to-1 at 70 mph. IAS. Second place Adastra, right, is two place, all wood aircraft with individual bubble canopies for occupants. Others shown include Briegleb BG-12, above, and Prue Standard, shown on opposite page.

Two-place, all-wood Adastra, above, has second bubble of cockpit obscured by high wing. Aircraft has a glide ratio of 35-to-1 at 55 mph.



Design top speed of the Prue Standard is 150 mph. Aircraft has a minimum sink rate of 2.15 fps. at 42 mph. and a stall speed of 39 mph.

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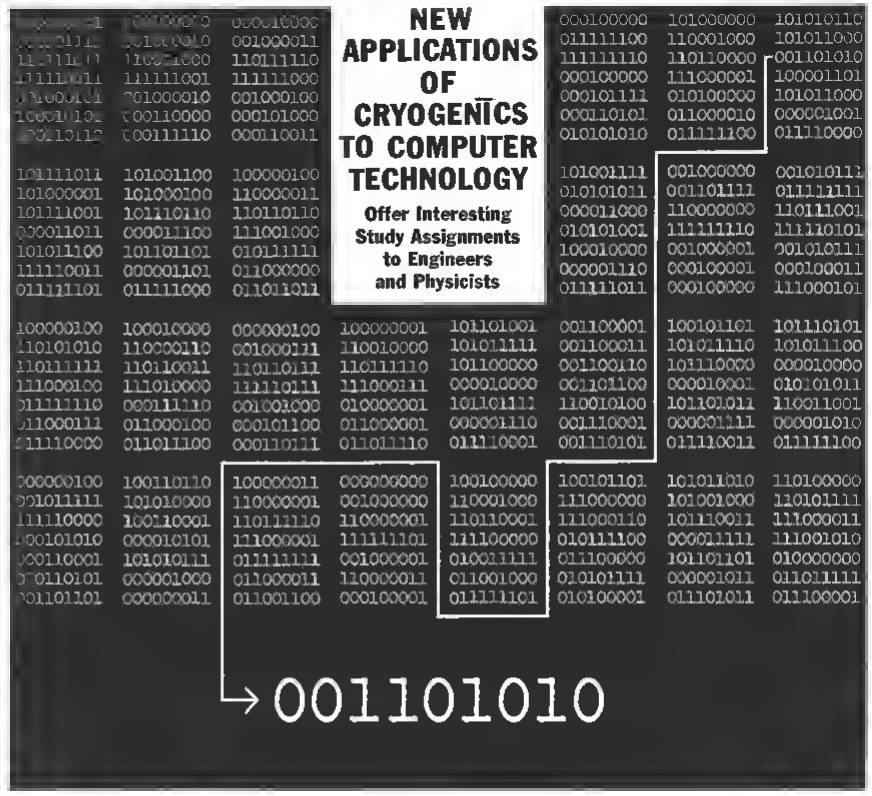

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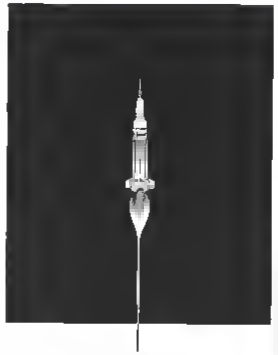

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Editorial Comment on Pentagon News "Weaponry"

'World We Live In'

Washington Evening Star—Oct 31

The Pentagon's manager of the news, Assistant Secretary of Defense Arthur Sylvester was the one through whom the government chose to channel to the public the news of what our ships and airplanes were doing to enforce the naval "quarantine" on Cuba. No newspaper correspondents were permitted on the scene. The traditional facilities usually provided for that purpose were denied, for reasons obviously phony. So Mr. Sylvester and his cohorts—carrying out orders, we are sure—were left in control of what was to be printed. Those whose business it is to gather and report the news reluctantly accepted this makeshift arrangement for the time being, for there was no alternative.

It subsequently was revealed that only those portions of the news were made available by Mr. Sylvester which he and other omniscient manipulators of public opinion decided in their infinite wisdom would best serve to create the "image" of this country's activities they wished to manufacture and place before our people and the world.

Mr. Sylvester is to be commended for his frankness at least. But he has let an ugly cat out of the bag. In his own words, as reported in The Star: 'I can't think of a comparable situation, but in the kind of world we live in, the generation of news by the government becomes one weapon in a strained situation. The results in my opinion justify the methods we used.'

Weigh those words. Their meaning is truly sinister. In an Administration that is becoming quite notable in its efforts toward achieving managed control of the news, Mr. Sylvester may have overlooked one likely result of the methods we used.' This result is that Mr. Sylvester and his superiors, from this time on, are suspect. They have, in our opinion, recklessly and thoughtlessly forfeited a confidence that in this country has been the rule, rather than the exception. What they say from now on, as arbitrarily established sources of public information, may be the truth. But that truth will be accepted with a grain of salt. The 'kind of world we live in' seems now to be a world in which the truth given the American people of what has happened is that part of the truth selected by officialdom to piece together a desirable image. That image may be a distortion, the inevitable result of an attempt to use the press and its news as instruments of national policy.

One may hope that having tasted the fruits of a use of power more readily identified with the Soviet Union with Hitler, Mussolini and a long string of new if lesser dictators than with our own country, those in high places will now realize that this fruit is poison and discard it before an antidote becomes necessary.

News as a Weapon

Washington Post—Nov 1

The acknowledgement by Assistant Secretary of Defense Arthur Sylvester that the government used its power to control information about the Cuban situation not only to safeguard the military security of the country, but to further national policy will alarm and distress many people.

The idea that the generation of news by the government becomes one weapon in a strained situation" is not an idea new to American government. The United States government had a disagreeable experience with this policy in World War I and out of that experience it developed certain principles it applied in World War 2. At the very outset of World War 2, it separated propaganda and censorship functions, putting one in the Office of War Information and the other in the Office of Censorship.

In the Cuban crisis most of the experience of World War 2 was disregarded. Secretary Sylvester combined the functions of propaganda, censorship and military control of the news. Since the crisis—at least in its initial stage—was not long lived it did not produce some of the bitter fruit that the protracted resort to such a policy surely would yield.

The consequences are serious enough. The statements of government will have a diminished credibility in any crisis hereafter and citizens will wonder if they are being told what is the truth or what the government thinks will favorably influence events. The American press, which is made by this means the unwilling servant of the government, will also have a reduced credibility at home and abroad. These are high prices to pay for getting the results which Mr. Sylvester thinks justify the use of news and access to news as a weapon. The prices can be cut if the government will promptly disavow its improvised tactics and proclaim a return to the sound principles of information pursued in World War 2, in case of future crisis of the kind.

Managing the News

The New York Times—Oct 31

The old problem of whether or not the ends justify the means cropped up in a form relatively new to the United States yesterday.

Arthur Sylvester, Assistant Secretary of Defense for Public Affairs in the Pentagon, frankly admitted the government had managed, controlled and dammed up the flow of news about the Cuban crisis, and he indicates it expected to continue to do so. He envisaged news as "part of ... weaponry" and declared flatly that "the results justify the methods we use."

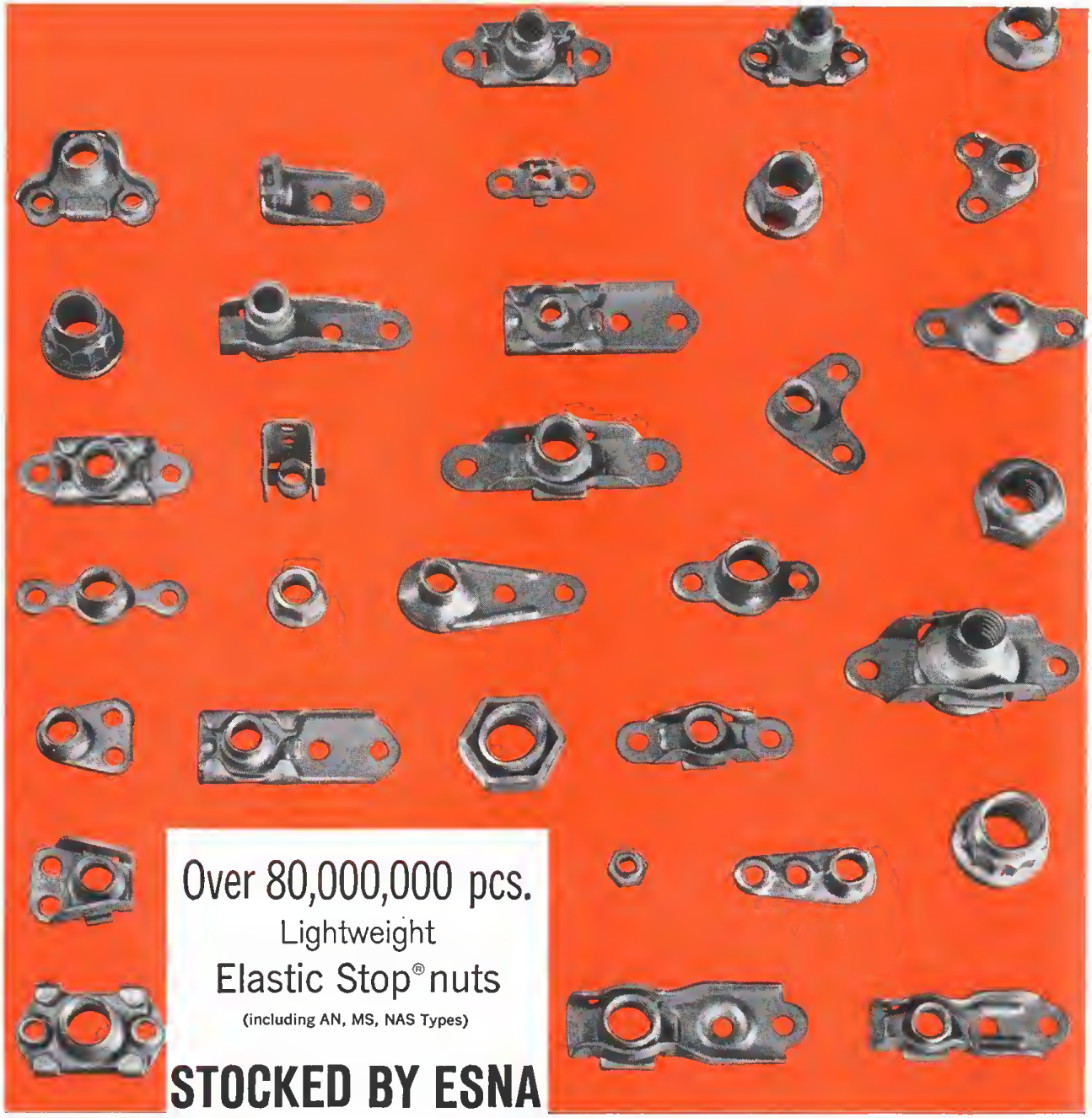
There is no doubt that "management" or 'control' of the news is censorship described by a sweeter term. There is no doubt that it restricts the people's right to know. There is no doubt that public positions upon great national issues cannot be intelligently formed unless the facts are available. There is no doubt that a democratic government cannot work if news of and about that government is long supressed or managed or manipulated or controlled.

There is also no doubt that in time of crisis a sense of responsibility and restraint on the part of all public information media is imperative. The withholding by voluntary restrictions or, in time of war by censorship of certain types of military and security information is imperative. But to attempt to manage the news so that a free press should speak (in Sylvester's words) in "one voice to your adversary" could be far more dangerous to the cause of freedom than the free play of dissent, than the fullest possible publication of the facts.

(Continued on p 145)

"Careful what you say to him, senor. He can't get over the fact that, this time last week, he was a Nuclear Power!"

London Daily Mail



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